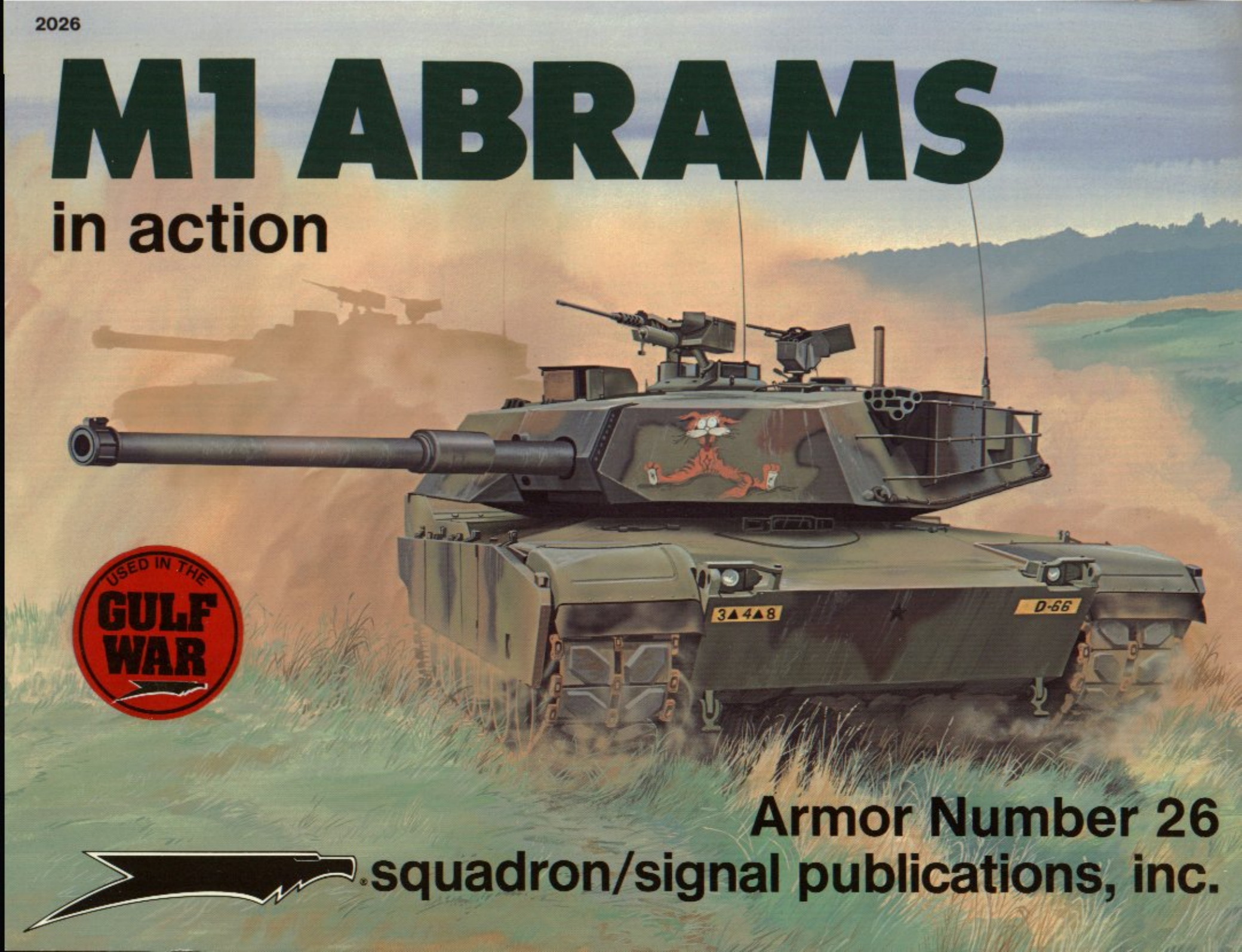
2026

M1 ABRAMS
in action



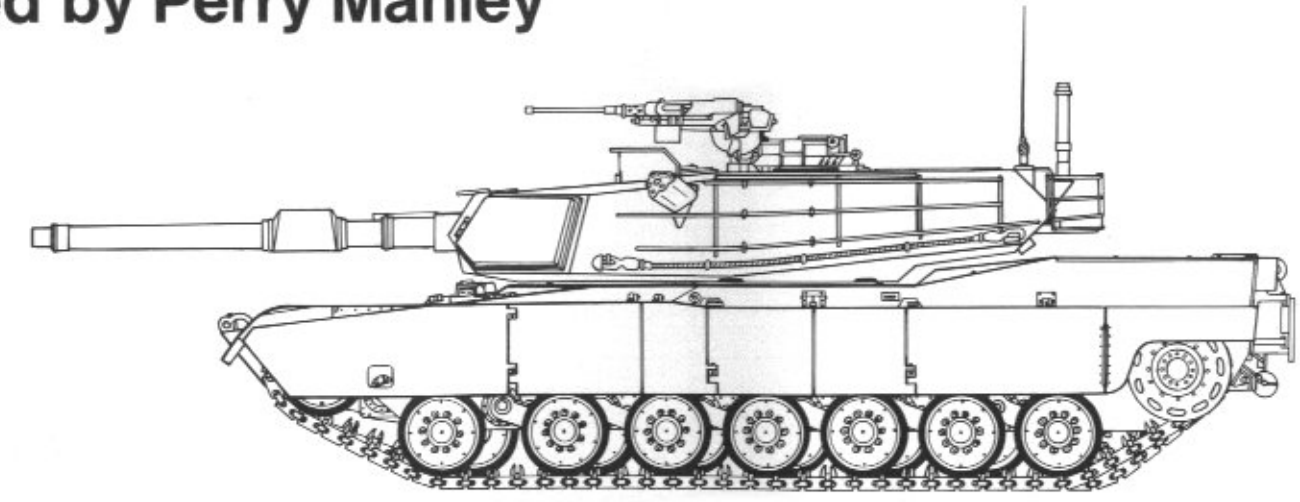
Armor Number 26

squadron/signal publications, inc.

M1 ABRAMS in action

By Jim Mesko

Color by Don Greer
Illustrated by Perry Manley



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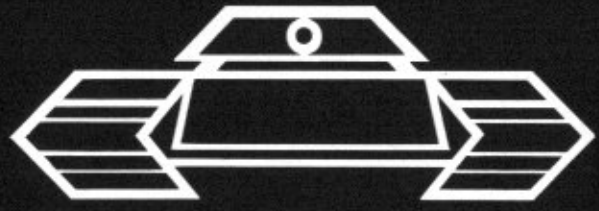
***Bill The Cat*, an M1A1 Abrams of Delta Company, 4/8 Cavalry, 3rd Armored Division on maneuvers in Germany during the Fall of 1987. The Abrams is the U.S. Army's main battle tank and is the primary fighting vehicle of American armored units assigned to NATO.**



M1 ABRAMS

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Dedication

To the members of the U.S. Army, Armor Branch, who help safeguard our country.

Photo Credits

This book could not have been completed without the help of the following people and organizations who gave unselfishly of their time, photographs, and patience. To each of them I would like to express my sincere thanks.

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I would like to add a special thanks to my mother who types my transcripts and to my wife who puts up with this routine with exceptionally good humor.

This M1A1 has taken a hull down position along a raised roadbed in Germany during exercise *Reforger 88*. From this position, the tank commander can see the enemy clearly, however, all that is visible of the M1 is the turret. (Green)

Introduction

The M1 Abrams is the end result of a long and stormy period of tank development during which the U.S. Army tried to find a replacement for the M60 series of main battle tanks. The M60 was the Army's main battle tank throughout the 1960s and 1970s and, although continually updated and improved, a replacement was long overdue. With this in mind the Army had begun seeking a replacement vehicle during the early 1960s.

MBT-70

With the continuing improvements to the M60 the Army was able to field a reasonably modern tank, however, unless a replacement was developed soon a serious gap would occur when the next generation of Soviet tanks entered service. During 1963, the Army entered in a joint program with West Germany to design a vehicle, the MBT-70, that would meet US/NATO armor requirements for the next decade. Cooperation with Germany would ensure that the tank was suitable for NATO and would reduce development costs.

Secretary of Defense Robert McNamara directed that the vehicle incorporate the latest technological advances to give the US a lead over future Soviet vehicles. The specification called for a Shillelagh gun/missile system, an automatic loader, layered armor, a hydro-pneumatic suspension, stabilized sighting system, a remotely controlled 20MM cannon, and an NBC filtered ventilation system. Most of these systems, however, were either experimental and/or under development, which led to delays and cost overruns. The joint nature of the project also led to problems when the partners disagreed on design features.

Prototype trials began during 1968 revealing more problems and causing further cost overruns. By 1969 the vehicle's unit price was five times greater than had been projected and Germany withdrew from the project. The Army, faced with increasing Congressional pressure, now proposed a simplified version, the XM803. The Congress, however, had been angered by the delays and cost overruns and cut funding for both programs during 1971. The MBT-70 program ended as one of the most ill conceived and costly projects ever undertaken and its legacy haunted the Army for years to come.

MBT-75/XM1

The loss of the MBT-70/XM803 left the Army without a replacement for the M60 and the Army quickly instituted another replacement program under the designation MBT-75. Congress stipulated that the new tank must be relatively simple, imposed strict cost guidelines, and required that the vehicle enter production as soon as possible.

Under close Congressional and press scrutiny, the Army approached the project somewhat differently. An MBT Task Force of users, trainers, and developers met to formulate the design. This was completed in August of 1972 and reviewed by an Army panel to eliminate excess costs and unnecessary features. Then the proposal was presented as a Development Concept Paper (DCP) to the Department of Defense (DOD), which approved the DCP in January of 1973.

The DCP called for concurrent operational and engineering trials. This testing method would significantly cut down development time, possibly saving as much as three years. The DCP also stated that selection of the full scale development vehicle would take place after a competitive evaluation of vehicles from two different contractors. In June of 1973 Chrysler and General Motors were each awarded prototype contracts. Both companies were to furnish a prototype, an automotive test rig, a separate hull and turret for ballistic tests, and maintain a ceiling of $500,000 (1972 dollars) for the prototype vehicles. DOD directed that one vehicle be powered by a 1,500 hp Avco Lycoming AGT-1500 gas turbine engine to evaluate the turbine against the diesel engine. The Chrysler entry was chosen to be fitted with the turbine, while the GM prototype would be diesel powered. Under these guidelines the prototypes, now designated XM1, began to take shape.

The XM1 prototypes emerged as sleek, low slung tanks with sloped armor and an elongated turret. Both had a crew of four; commander, gunner, loader, and driver. The suspension utilized the best features from a number of earlier systems. The seven roadwheels on each side of the hull were mounted on individual torsion bars with two return rollers and three rotary shock absorbers. The suspension was protected by armored side skirts that were hinged to allow access to the running gear. The Allison X1100-3B automatic transmission, with four forward and two reverse gears, drove the rear mounted drive sprockets through a three element torque converter. The internal fuel capacity of 492 gallons gave the prototype a range of 295 miles at 25 mph.

The wide spread use of shaped charge warhead weapons such as the Soviet RPG-7 rocket and Sagger wire-guided anti-tank missile during the 1973 Arab/Israeli War, raised doubts in Congress about the role of the tank in modern warfare. The press openly questioned the need for tanks because of high Israeli losses. These losses, however, resulted from poor tactics, not the superiority of shaped charge hand-held anti-tank weapons. The Army had specified that the XM1 be fitted with Chobham armor, a British development that incorporated layers of ceramic bars between steel armor and offered increased protection from both kinetic energy and shaped charged warheads.

The main armament of both XM1s was the M68 105MM rifled cannon. Thanks to advances in ammunition, which had increased the gun's range and power, the M68 had been able to keep pace with developments in Soviet armor. Secondary armament consisted of a coaxial 7.62MM machine gun mounted in the starboard side of the gun mantlet, a .50 caliber machine gun on the starboard side of the turret roof, and a second 7.62MM machine gun on the port side.

The Army was aware of new tank guns being developed in Europe and conducted tests during 1975 to determine the best available gun for the XM1. These tests were influenced by an agreement with Germany aimed at increasing weapons standardization between NATO partners. The weapons tested were the British 110 and 120MM guns and the German 120MM gun. These tests revealed that there was little difference between the German and British guns, therefore, the German gun was selected to meet the standardization agreement. The Germans, however, were having difficulty perfecting the combustible case ammunition and breech mechanism of the gun. As a result the XM1's gun trunnion was modified to allow the 120MM gun to be installed later, when and if its problems were resolved.

The MBT-70 attempted to bridge the technical gap between American and Soviet tank designs and give the US a decided superiority. The MBT-70 used a number of experimental and untried systems which resulted in excessive cost overruns. Faced with these increasing costs Congress cancelled the program during 1971. (U.S. Army)

Both Chrysler and GM delivered their prototypes for testing during early 1976. Germany also entered the Leopard II AV (American Version) in the competition, however, the prototype would not be available until the following September. Rather than wait, testing was begun on the two American entries and in October the winner was announced. The DOD selected the turbine powered Chrysler vehicle for Full Scale Engineering Development (FSED) despite an Army preference for the diesel powered GM entry. The Army felt that the diesel posed fewer developmental risks, while DOD civilian officials felt that the turbine offered greater potential.

The selection of the Chrysler version sparked heated German protests. They argued that the selection killed any chance that the Leopard II AV would be evaluated fairly. The Army replied that it would evaluate the Leopard II fairly, however, despite these assurances the Leopard was withdrawn during January of 1977. In May of 1977 the US and Germany agreed to cooperate on standardizing a number of components in both the XM1 and Leopard II, such as the armament, power train, and tracks. The Army adopted the German main gun and, as it turned out, this was the only area where cooperation worked. The Germans would not adopt the XM1's turbine and automatic transmission, while the US rejected the Leopard's track as too heavy, noisy, and having excessive vibration.

While these talks were going on, eleven XM1 pre-production vehicles had been delivered and began testing. These vehicles differed from the prototype in having a redesigned turret which featured a new gun shield, revised sight mounts, and side mounted stowage boxes. Since the engineering and operational tests were conducted at the same time, problems arose which were blown out of proportion in the press. The Army had anticipated these problems, however, and overall development time was being significantly reduced. This was overlooked by Congress, which seemed more concerned with the publicity than the facts.

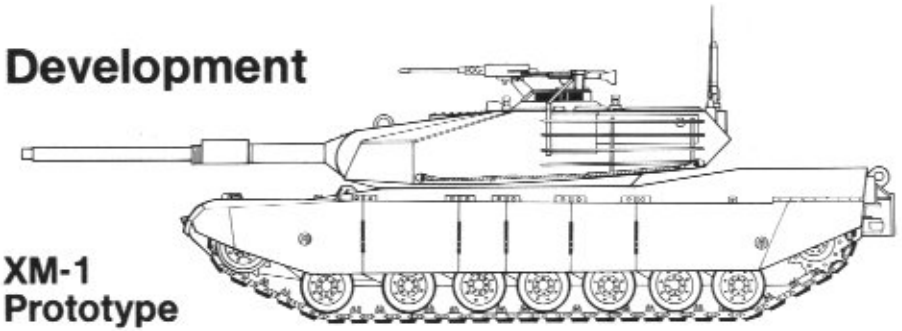
Problem areas were the air filter system, track life, transmission, mud buildup, and fuel systems. Once the problems were identified, three XM1 prototypes were modified to test solutions. The filter system was revised, cutting down on dust ingestion which also solved related turbine blade problems. Mud scrapers, discharge ports, and a suspension modification reduced the mud problem. Track life remained a problem because of an unrealistic requirement. The fuel system and transmission were modified and now met all requirements. Throughout 1978 and 1979 testing continued, and all major problem areas were solved. During late 1979 DOD authorized production of fifty-four vehicles under the designation M1.

Chrysler's entry was also low and streamlined, but was powered by a turbine engine which the Army viewed as a possible developmental risk. Civilian officials at the Department of Defense, however, overruled the Army and picked the Chrysler entry as the winner of the competition. (Wagner)

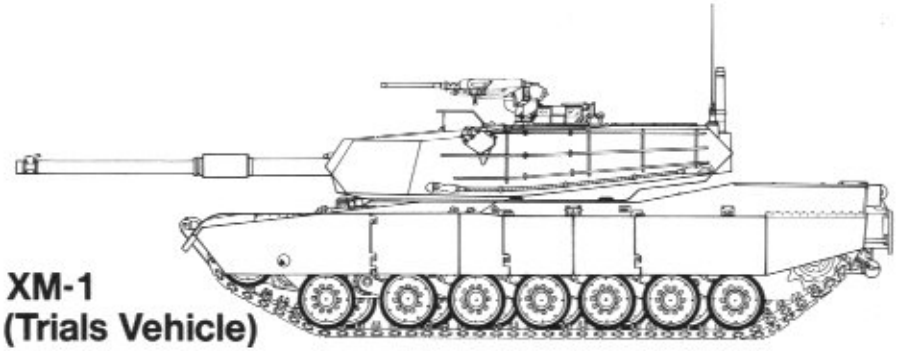
The General Motors XM1 prototype was powered by a conventional diesel engine. The vehicle was intended to offer the Army a modern, low silhouette vehicle with relatively few developmental risks and was favored by the Army. (Wagner)

One of the XM1 pilot vehicles, painted in a three tone camouflage scheme, rests outside the Detroit Army Tank Plant during 1978. Extensive tests with these vehicles showed that the XM1 was a robust, reliable vehicle. The main problem areas encountered were with the turbine air filters, transmission, and fuel supply. (Wagner)

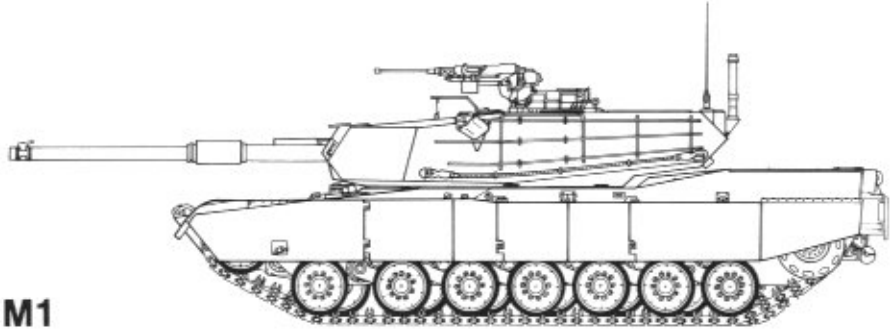
Development



XM-1
Prototype

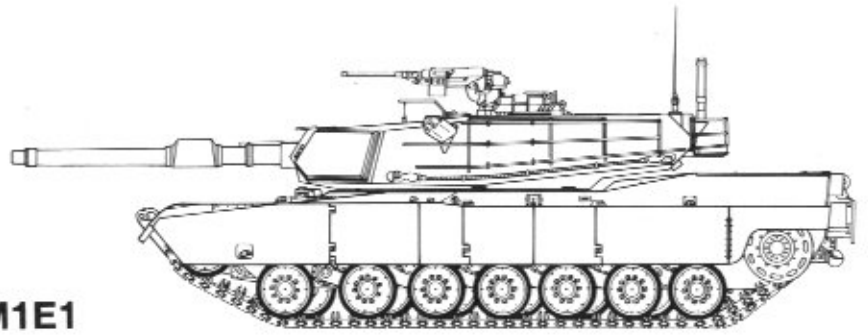


XM-1
(Trials Vehicle)



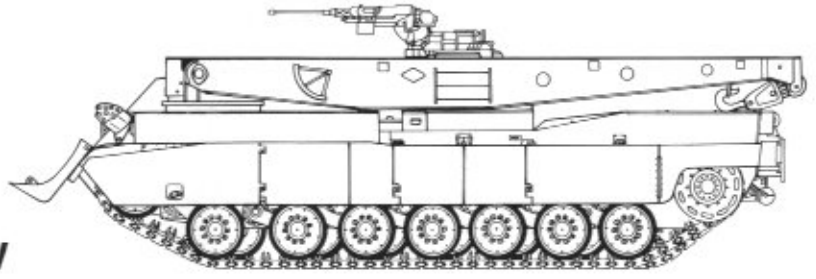
M1

IP M1



M1E1

M1A1



ARV

XK-1

M1 Abrams

On 28 February 1980 the first production M1 was turned over to the Army at the Lima Tank Plant in Ohio. During the presentation ceremony the tank was officially christened the "Abrams" in honor of General Creighton Abrams, by his widow. GEN Abrams had been a World War II tank commander and the commander of U.S. Forces in Vietnam.

The production M1 is unlike any other tank ever developed for the U.S. Army. The hull and turret had a far more angular and streamline shape than the squat round shapes which had characterized earlier US tanks. Armored side skirts enhanced this low profile and gave the M1 a decidedly 'Teutonic' look.

The production M1 differed from the trials vehicles in a number of ways. The turret roof had been modified and extended rearward some eight inches by the installation of a vertical plate at the rear of the turret between the antenna posts. This plate gave the turret a decided squared off appearance. The crosswind sensor was relocated from the top of the rear turret edge to a platform centered on the extended rear turret vertical plate.

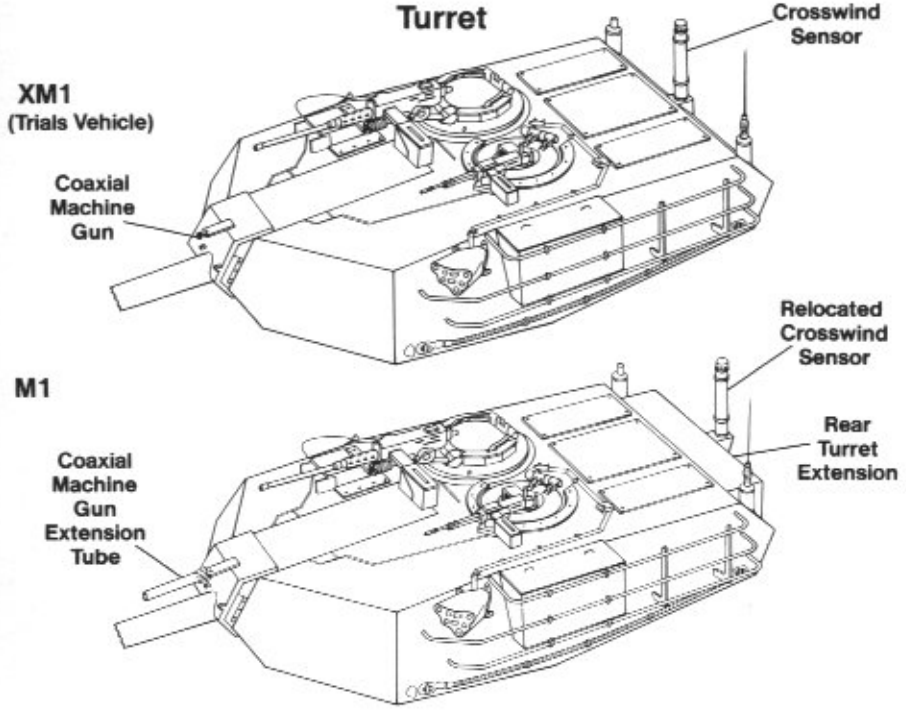
The crew mounting step at the bottom of each front side skirt was changed from a angle iron step to a flexible cable step because the original step was found to be easily damaged in the field. The original single headlights on the forward glacis plate were replaced by twin headlights, one of which is believed to be an infrared light. The drive system was changed with the rear drive sprocket being covered by a 25 inch circular track retainer plate.

The secondary armament was changed with the loader's MAG-58 machine gun being replaced by a M240 7.62MM machine gun. The loader's gun mount was also changed from a pivot mount to a cradle mount to allow for greater flexibility in action and the coaxial machine gun in the starboard side of the main gun mantlet was fitted with a gun barrel extension tube.

The Abrams has taken advantage of a number of technological advances which gives it a definite edge over enemy tanks on the battlefield. The Chobham armor and angular design provides the Abrams with the maximum protection possible against kinetic energy anti-tank rounds and shaped charge warheads. Internally the Abrams crew is protected in a number of ways. Armored bulkheads separate the crew compartment from the fuel tanks while sliding armored doors cover the ammunition stowage bins. Ammunition stored inside the turret bustle is separated from the turret interior by armored doors and in the event of a hit, blast panels installed in the turret roof channel the explosion upward, away from the crew. Fire protection is much improved over earlier tanks with an automatic HALON fire extinguishing system installed in the engine compartment which can extinguish any fire within a few seconds.

The 1,500 hp Avco-Lycoming AGT-1500 turbine engine gives the Abrams startling performance. The 60 ton vehicle has a top speed of 44 mph on the road and 35 mph cross country. Additionally the engine has the added advantage of being extremely quiet. Even at full power, the engine emits only a muted whine giving the Abrams a tactical advantage over noisy diesel engined tanks. Maintenance on the AGT-1500 is far easier than on earlier diesel engines. An engine change on the M1 can be performed in an hour, as compared with four hours for the diesel engine in an M60. Time between overhauls (TBO) is estimated to be 1,800 hours (or 12,000 miles), about three times greater than that for a diesel engine. The modular construction of the turbine also makes routine maintenance much easier and faster. Engine components can be changed without having to dismantle the entire engine. This also simplifies logistics since fewer parts are required to be on hand. A major advantage of the turbine is the flexibility of fuels than can be used. Although designed to run primarily on either diesel or jet fuels, the turbine can be operated on gasoline. This flexibility can make fuel acquisition in a combat situation far easier.

On 28 February 1980, the first production M1 was christened "Abrams", by the widow of General Creighton Abrams at the Lima Tank Plant. The M1 carried the name "THUNDERBOLT" on the turret in White, the same name carried on GEN Abram's tank during the Second World War. (Wagner)



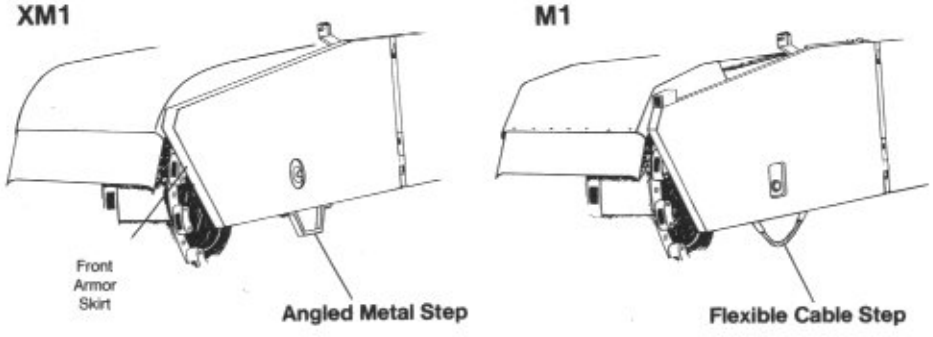
Of the crew, only the driver is positioned in the hull, while the tank commander (TC), loader, and gunner all occupy the turret. The driver's position is located in the center of the forward hull and access is gained through a hatch which is hinged to open upward and swung starboard. The driver has three viewing scopes within the hatch for outside view when driving shut down, as well as a passive infrared night vision viewing periscope. The driver is seated in a semi-reclining position and uses a handlebar power/steering system which is quite similar to that of a motorcycle.

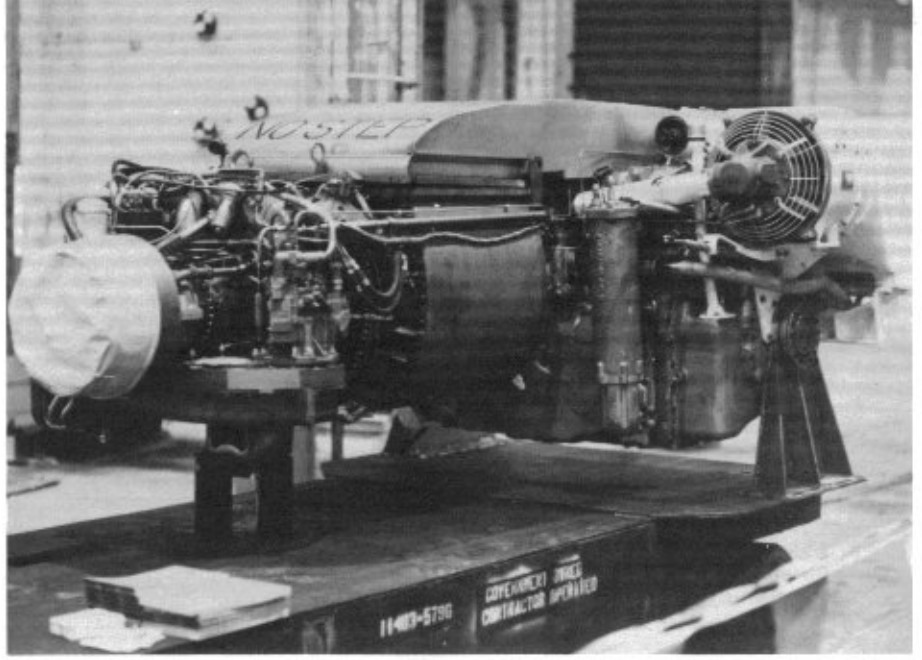
The heart of the Abrams is the fire control system which is a fully integrated laser range finder and digital computer. The computer processes information on wind, temperature, ammunition type, vehicle movement, and equipment sensors, giving the M1 a ninety percent first round hit probability. The gun is also stabilized for firing on the move, allowing the Abrams to "shoot-and-scoot" with a high degree of accuracy. An infrared thermal sighting system allows the commander and gunner to locate targets day, night, in haze, in fog, or in the smoke of the battlefield. The 105MM rifled cannon can fire a variety of ammunition including the newly developed depleted uranium armor piercing penetrator rounds.

The early production vehicles were extensively tested to determine how the M1 would hold up during day to day operations in the field. As with any new system, bugs had to be worked out but there were no insurmountable problems. The M1 did, however, face a storm of unwarranted Congressional and press criticism until testimony by a number of actual users, armored force Sergeants, ended much of the Congressional criticism. Approval for full scale production was granted during the Fall of 1981 and by early 1982 the assembly line was in full operation. Chrysler, however, because of financial troubles, was forced to sell their tank production facility to gain much needed capital. The facility and rights to M1 production were purchased by the General Dynamics Land Systems Division.

Production rates for the M1 have gradually climbed from thirty a month during 1981 to sixty during 1982 and then seventy a month for 1984. Initial Army plans called for a production run of 3,300 tanks, however, after closed door hearings held in 1983, Congress authorized production of 7,000 vehicles. At the present time the Army is giving serious consideration to increasing production to 12,000 vehicles, although a final decision has yet to be reached. Possible foreign orders may raise this even higher if ongoing overseas sales proposals are successful.

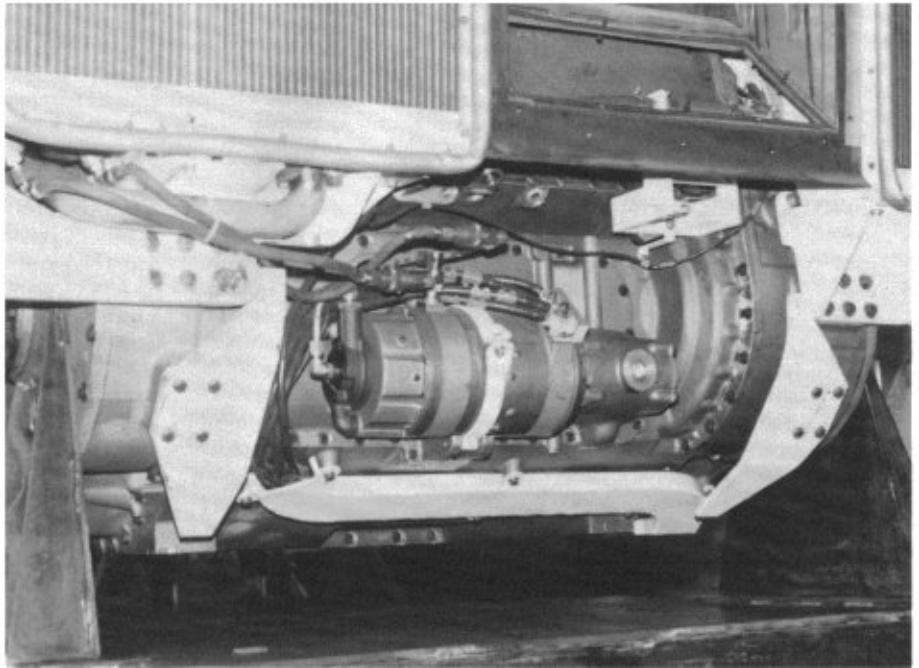
Crew Boarding Step





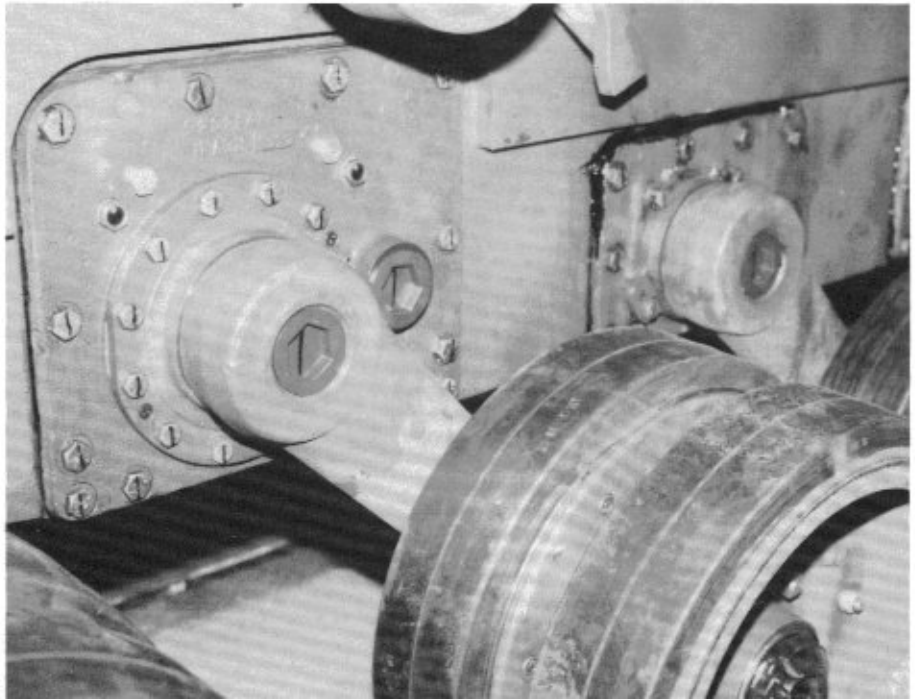
The M1 was powered by a 1,500 hp Avco-Lycoming AGT-1500 turbine engine. Although the turbine consumes more fuel than a diesel power plant, its smaller size, lighter weight, ease of maintenance, longer life span, and instant power were all factors which led to its selection over the diesel engine. (U.S. Army vis Armor)

The entire engine assembly of the M1 can be changed in an hour, a substantial improvement over the four hours required to change the diesel engine of an M60. The modular construction of the engine also allows for quick changes of components, easing maintenance requirements. (Wagner)

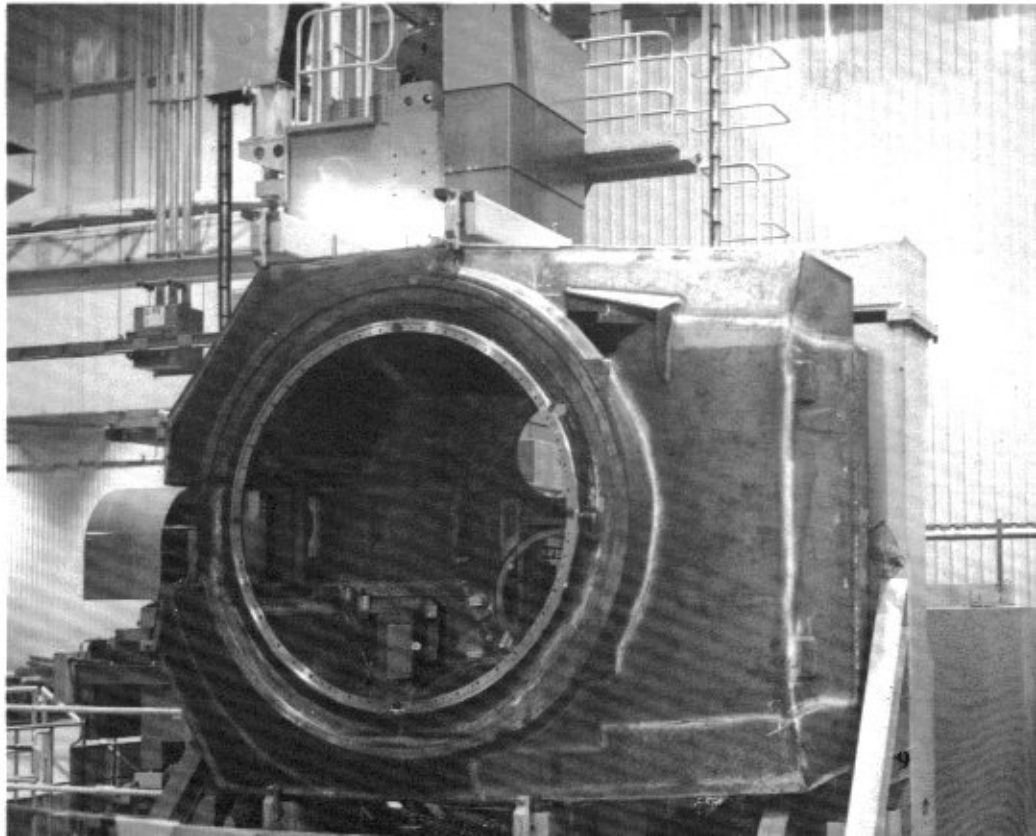


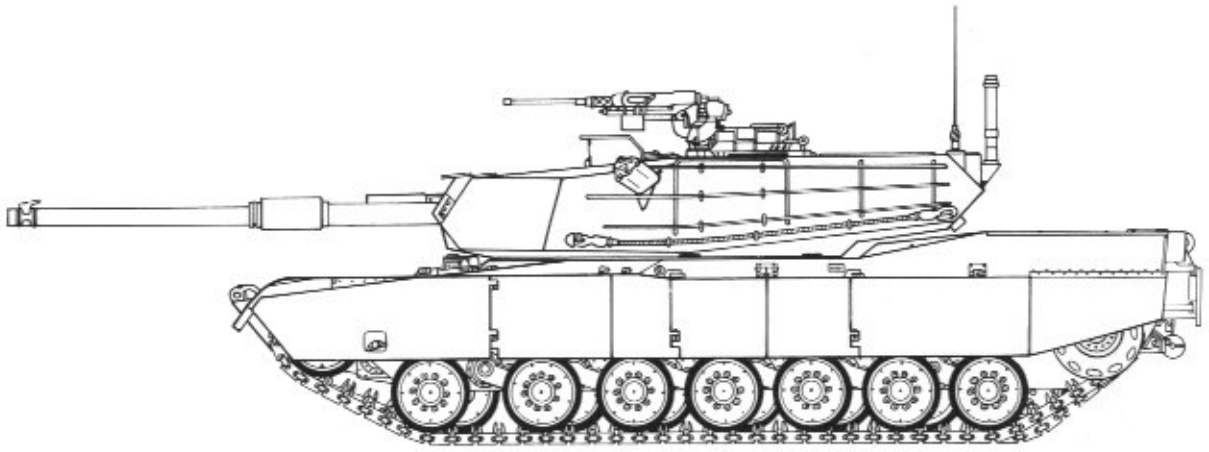
(Above) The hull of an M1 rests on a dolly ready to be moved to the assembly line. The large square openings in the sides of the hull are the attachment points for the bogie wheel assemblies. (Wagner)

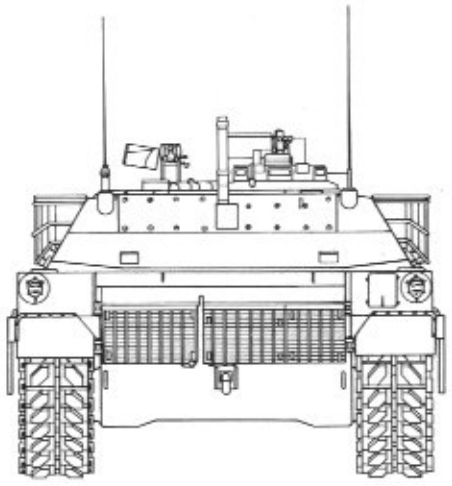
(Below) Completed bogie wheel assemblies are attached to the hull by twelve bolts. There are two sighting gauges for checking oil levels above and to the right and left of the circular attachment plate. (Wagner)



(Below) Once the turret shell has been completed it is then positioned for technicians to install the different equipment housings, wiring bundles, and attachment points needed for completion. (Wagner)

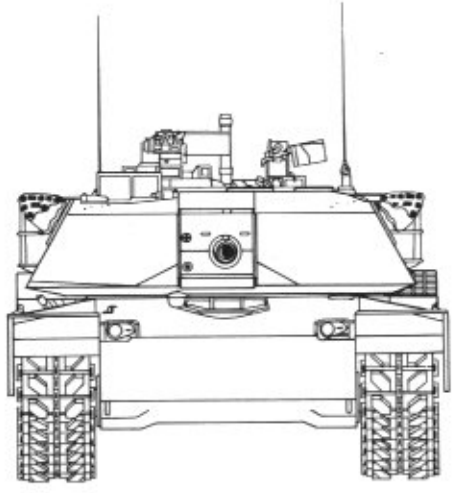


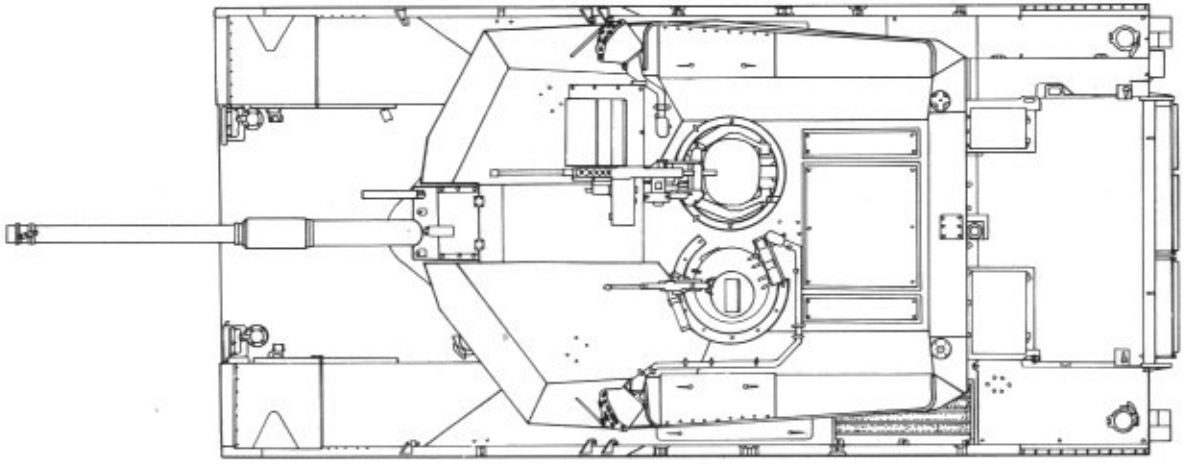




Specifications
M1 Abrams

Length	32 feet
Height	7 feet 9 inches
Width	12 feet
Maximum Weight	60 tons
Powerplant	One 1,500 hp Avco-Lycoming turbine engine
Armament	
Main:	M68 105мм rifled cannon
Secondary:	One .50 caliber machine gun Two 7.62мм machine guns.
Performance	
Maximum Speed	44 mph
Range	275 miles
Crew	Four



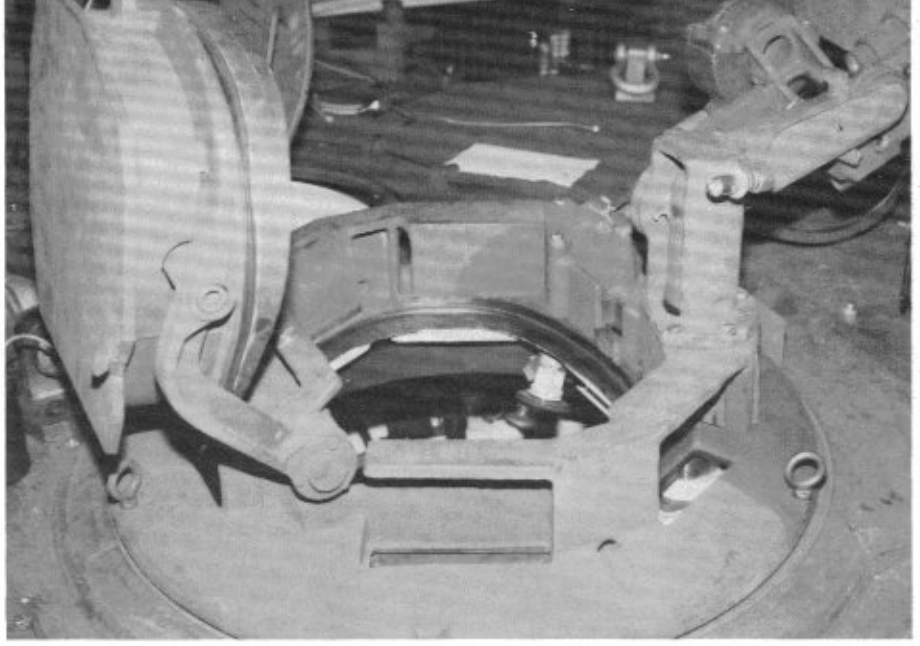


(Above) Workmen install equipment on a nearly completed M1 hull on the assembly line. The code H-4 on the hull is the factory identification code for the hull which will be mated with a turret with the same factory code during the final assembly process. (Wagner)

(Below) The M1 has a low sleek look compared to other US tanks such as the M48 and M60. The main external difference between production M1s and the trials vehicles was in the turret which was extended rearward by an eight inch plate at the rear of the turret. (Wagner)

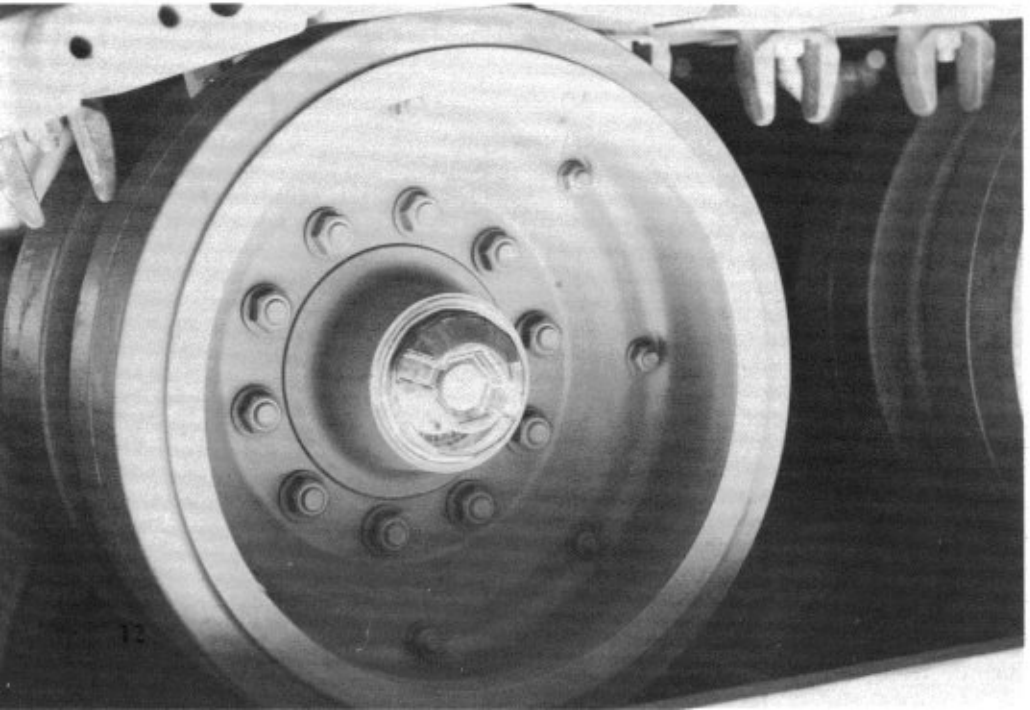
(Above) A nearly complete turret, fitted with the 105MM gun and turret basket, moves down the assembly line. The screws sticking up in front of the commanders station mark where the cover for the gunner's sight will be located and bolted down. (Wagner)

The M1 incorporated numerous features to increase survivability. The three large plates on the turret roof are blast panels which are designed to channel an ammunition explosion out through the roof in the event of a hit. The folded tube in the foreground is the windspeed/ temperature sensor. (Mesko)

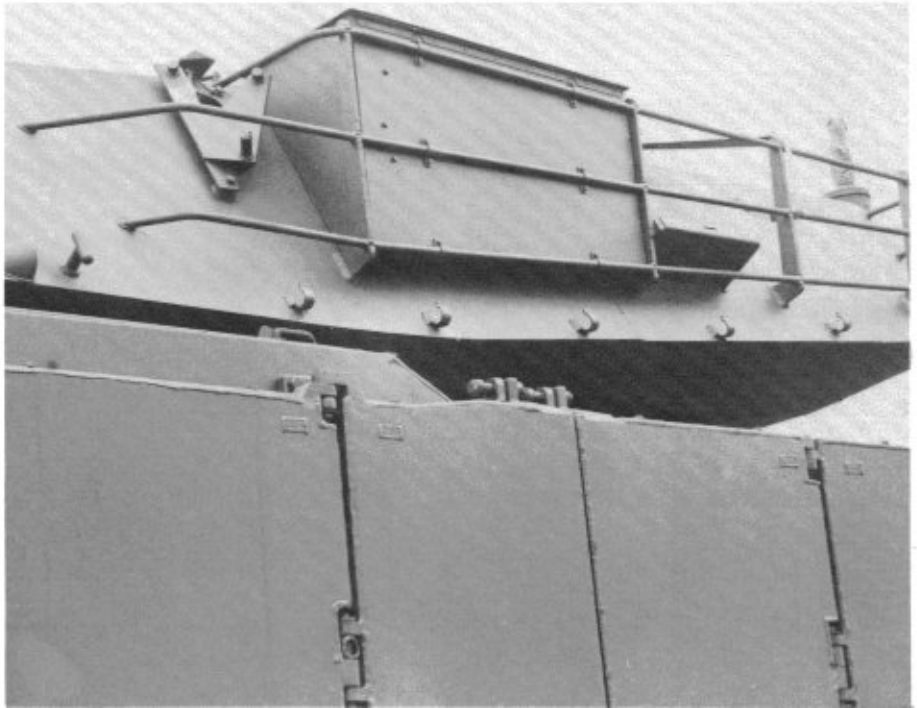


The commander's hatch can be pivoted to a horizontal position to provide overhead protection from shell bursts. In this way the tank commander can raise the hatch to get a clear view of the area yet remain protected from enemy fire. (Wagner)

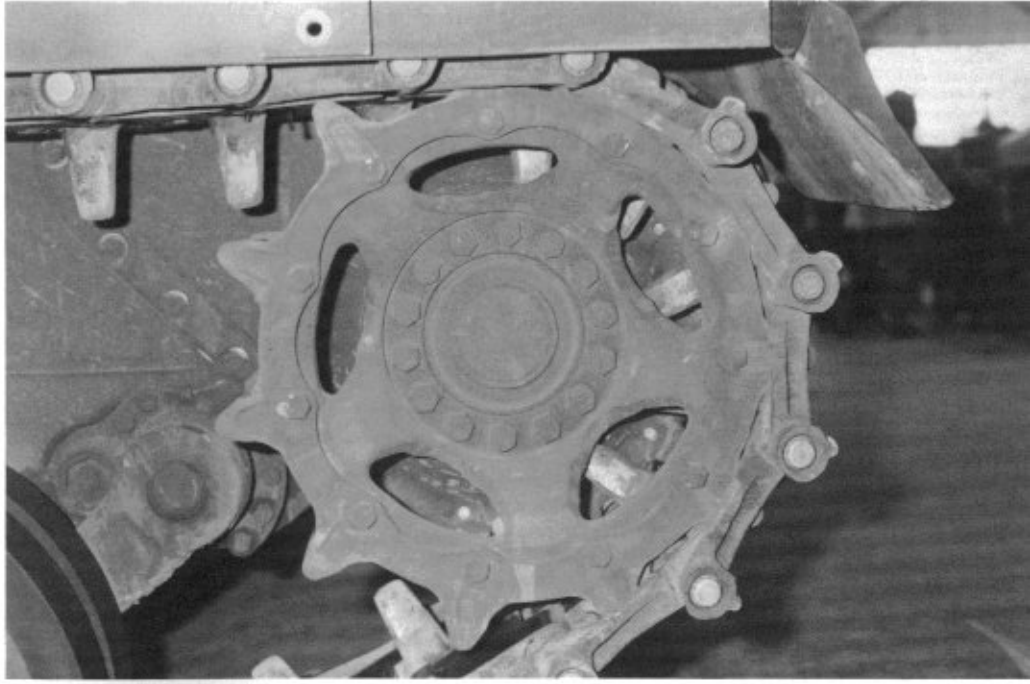
A clear plastic cap over the torsion bar axle on each road wheel allows the crew to easily check the torsion bar oil level to determine if the level is correct or needs to be adjusted. (Mesko)



Equipment stowage boxes are provided on both sides of the turret. A mount for a jerry can is located behind the stowage bin while the mount for the smoke grenade launcher is in front of the bin. The armored side skirts are hinged to allow access to the running gear. (Mesko)



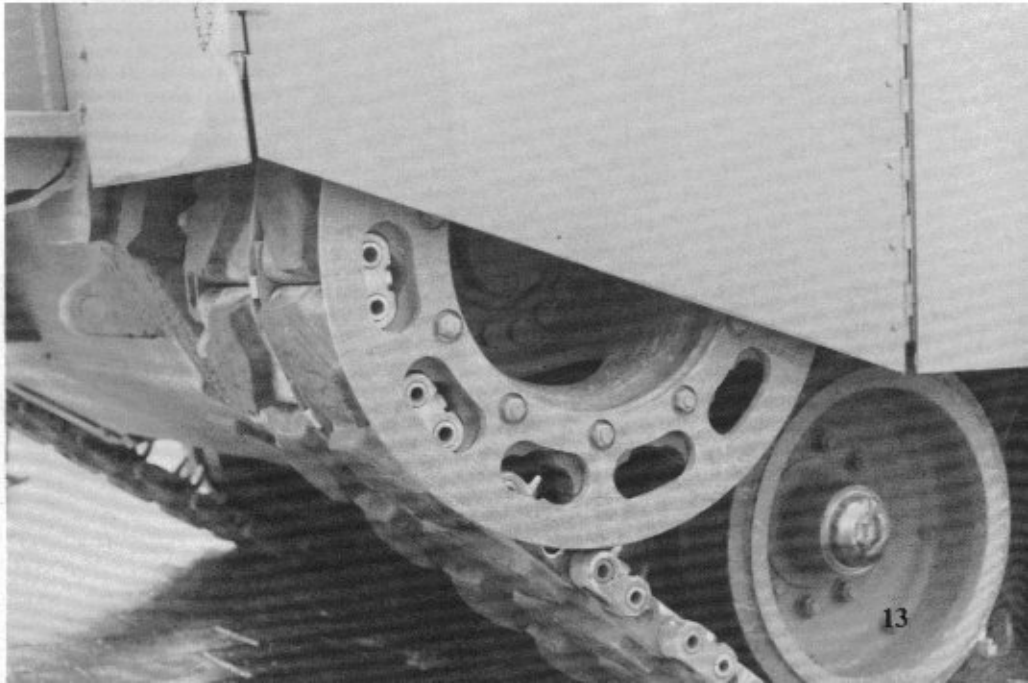
This early production M1 is securely chained down on a railway flat car for delivery to an Army unit. The gun barrel, sights, and all glass parts have been taped over to protect them during shipment.(Mesko)



The XM1 trials vehicle drive sprocket was prone to throwing tracks whenever mud built up between the hull and the sprocket. To correct this problem, a track guard was installed on production M1s. (Wagner)

Additional equipment for the M1 is stored in the wooden box secured to the rear decking. Besides covering the gun barrel opening, the protective tape also covers the muzzle reference system to protect it from damage. (Mesko)

Production M1s had a modified rear drive sprocket with a twenty-five inch track retainer plate. It was hoped that this would cut down on thrown tracks, however, the plate was deleted on later models as it proved to be ineffective. (Wagner)

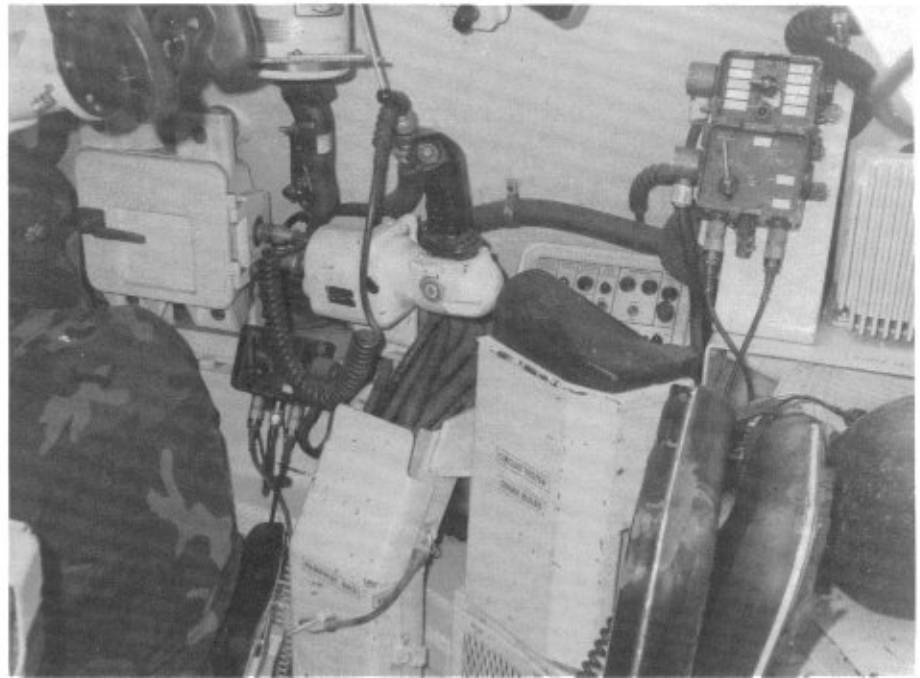


An M1 crewman enters the driver's hatch on the first production M1. Like the earlier M48 and M60 tanks, the M1's driver is located in the center of the hull with a hatch that is pushed up and swung away to gain access to the tank. (Wagner)

The M1's driver sits in a reclining position in the front center of the hull surrounded by his controls. The main driving controls are a set of motorcycle type handlebars which can be positioned in a number of ways depending on the wishes of the driver. (U.S. Army via Wagner)

An M1 gunner mans his station inside the turret of the Abrams. His hand is on the gun sight, directly above his head is the tank commander's sight, while to his left is the breech for the M68A1 main gun. The coaxial machine gun is mounted just to the right of the main gun. (Green)

The box behind and below the gunner is the main fire control computer. Directly behind it is the commander's azimuth control and gun control pistol grip. Above the circuit test box is the grenade launch control panel while the intercom control panel is above the commander's folded seat. (Green)



M1E1

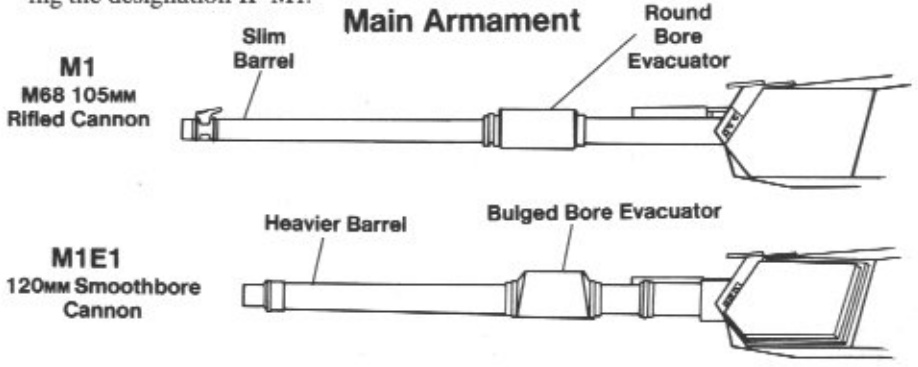
As a result of an agreement between West Germany and the United States plans were set in motion to standardize as many components as possible between the M1 and Leopard II main battle tanks. One of the major areas under consideration was the main armament to be installed on both tanks. After testing various American, British, and German guns, it was decided to arm both vehicles with the newly developed German 120MM Rheinmetall smoothbore cannon.

This decision caused several problems for the M1 program. While a more powerful weapon than the M68 105MM gun, use of the German gun would raise the overall costs of the M1. A number of Army officials were also concerned that fewer of the larger 120MM rounds could be carried in the vehicle. Internal ammunition capacity for an M1 armed with the 105MM gun was fifty-five rounds, while only forty rounds of 120MM ammunition could be carried. Additionally, the Germans had experienced a number of problems during the development of the gun and its combustible case ammunition and there were concerns that the ammunition might present problems under field conditions.

These concerns led to an Army decision to arm initial production M1s with the proven M68 105MM rifled cannon until such time as all the technical difficulties had been worked out with the German gun. To ease transition to the new weapon, a redesigned gun trunnion was installed in production M1s to allow the 120MM gun to be fitted without a major redesign of the turret, or interruption to the production line.

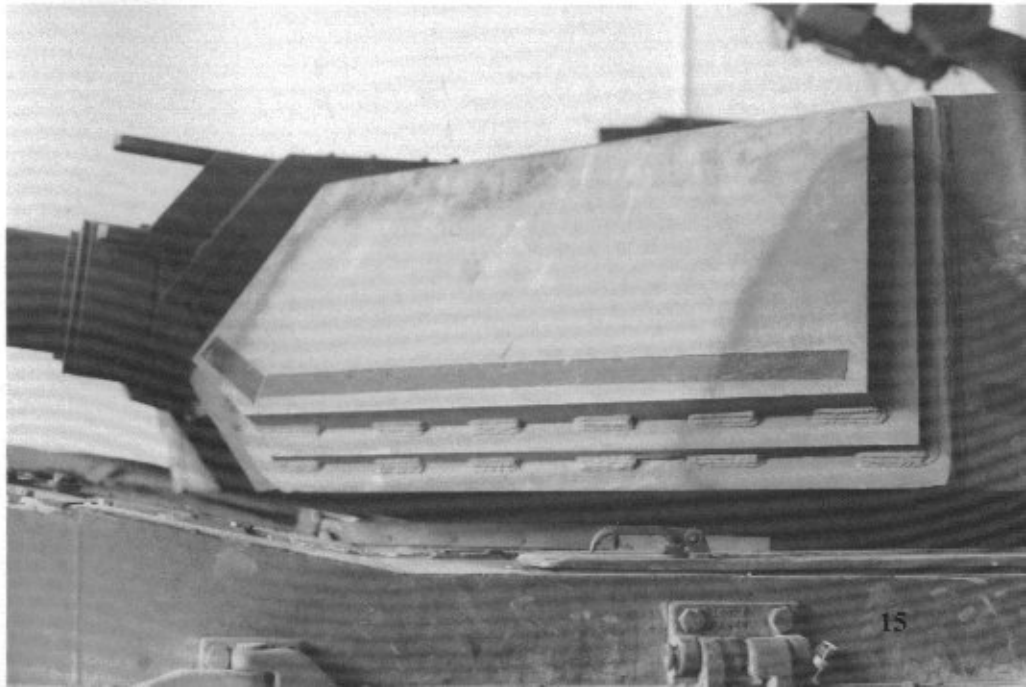
As the Germans worked out the technical problems with the gun system, plans were made to test the weapon in a production M1. The first weapons, designated the XM256, arrived for testing at Aberdeen Proving Grounds during early 1980. Initially, it had been intended to install an American designed breech mechanism because the German breech was felt to be overly complicated and unreliable. This became unnecessary, however, when the Germans redesigned the breech themselves.

During early 1981 the first of fourteen M1s were fitted with the 120MM cannon under the designation M1E1. These fourteen vehicles were intended to field test the gun system, along with other improvements intended for production M1s. Extra armor plate was welded to the lower front hull and turret faces to simulate a planned increased frontal armor configuration. In response to crew complaints about the lack of internal storage space and the awkwardness of the equipment straps on the turret rear, a bustle rack was installed on the rear of the turret replacing the straps and an additional storage bin was added to the turret side. This rack and bin helped alleviate the internal storage problem. Tests with the new gun and other modifications went well and features such as the new stowage rack and proposed armor configuration were quickly cleared for production. These changes were incorporated into the production line with the modified M1s receiving the designation IP M1.



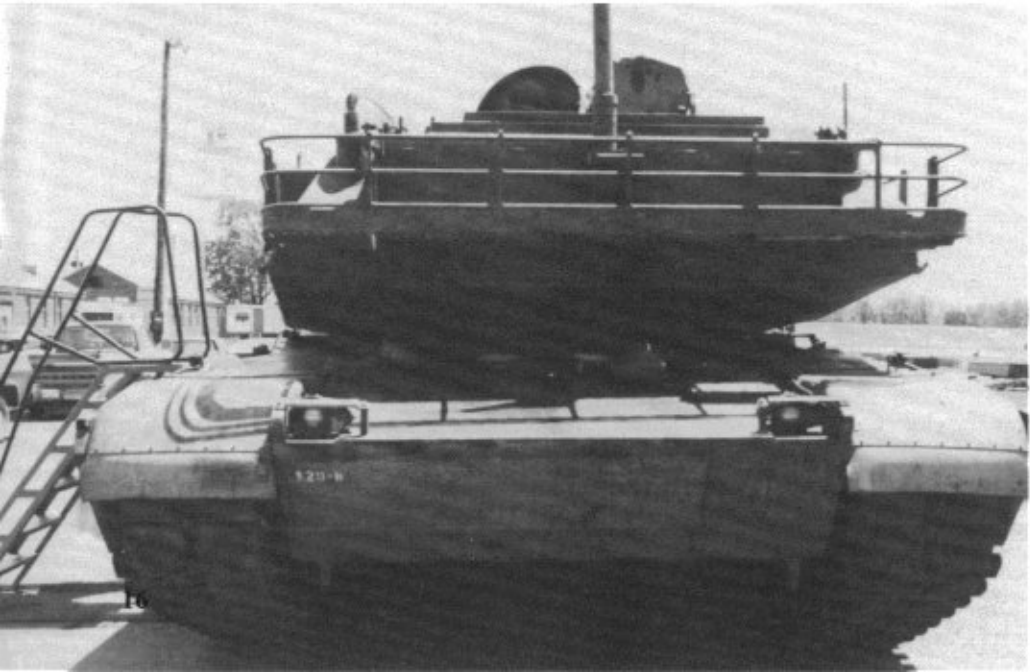
The most obvious change between the M1 and the M1E1 was the German manufactured 120MM main gun. Fourteen M1s were fitted with the new weapon during 1981 to test the gun/turret combination. (Green)

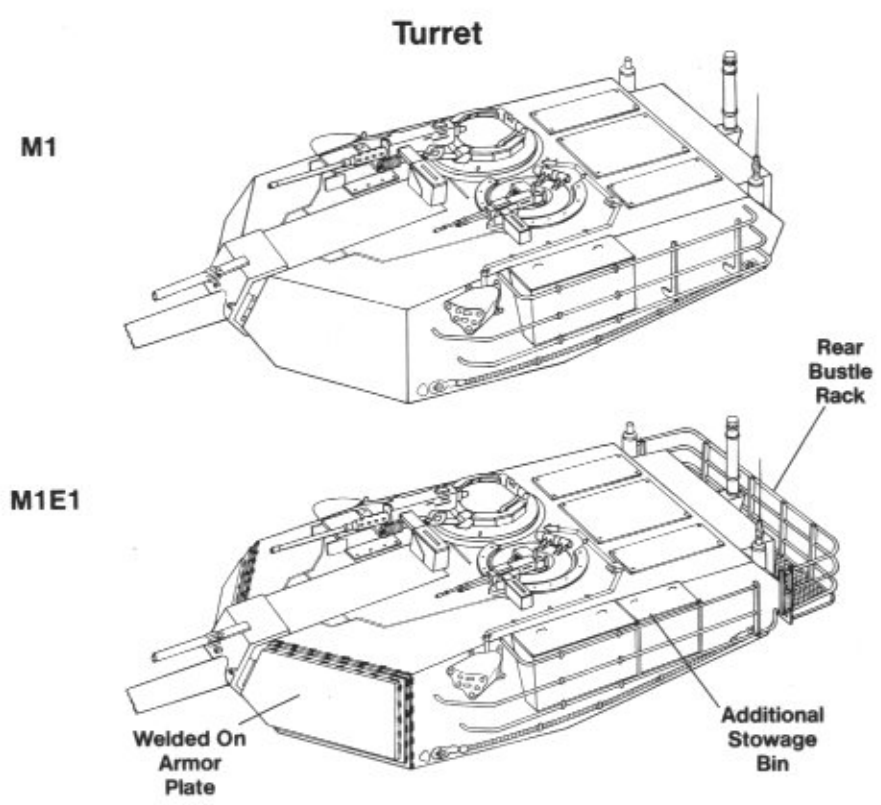
In addition to testing the German gun the M1E1 was configured with additional armor plates welded on the hull front and turret face to simulate the extra weight which a new armor configuration would add to the M1. (Mesko)

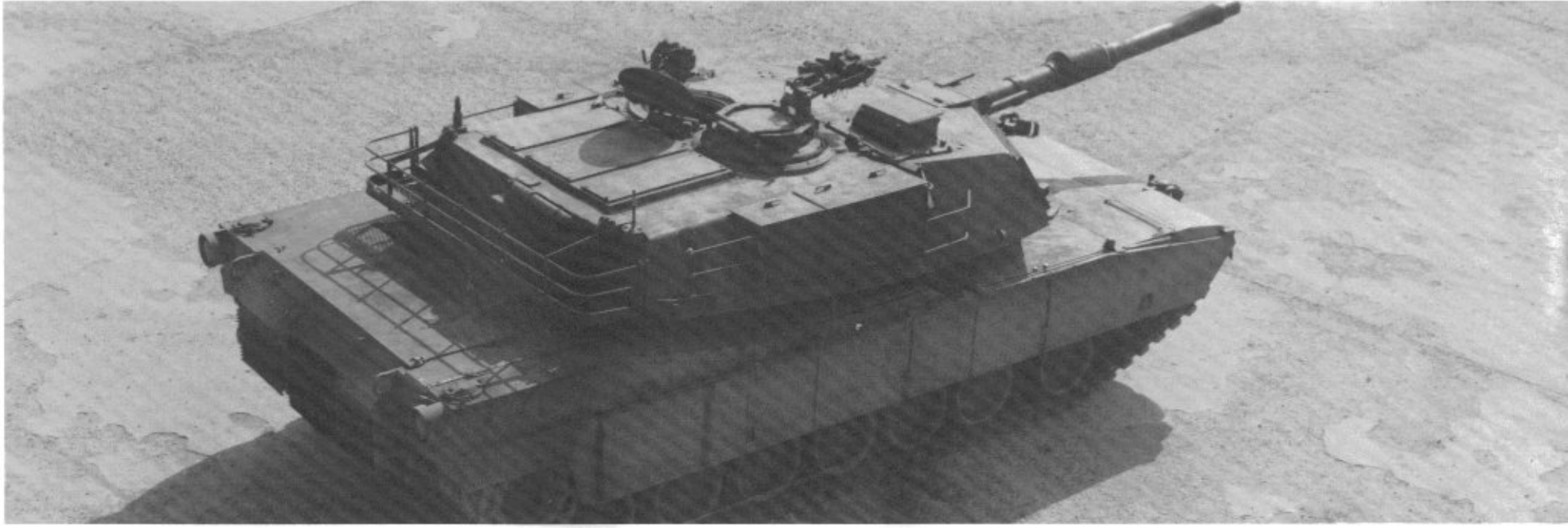


This early M1E1 lacks the simulated armor weights and stowage rack on the rear of the turret. The turret stowage boxes were later modified to extend all the way to the rear of the turret. (U.S. Army)

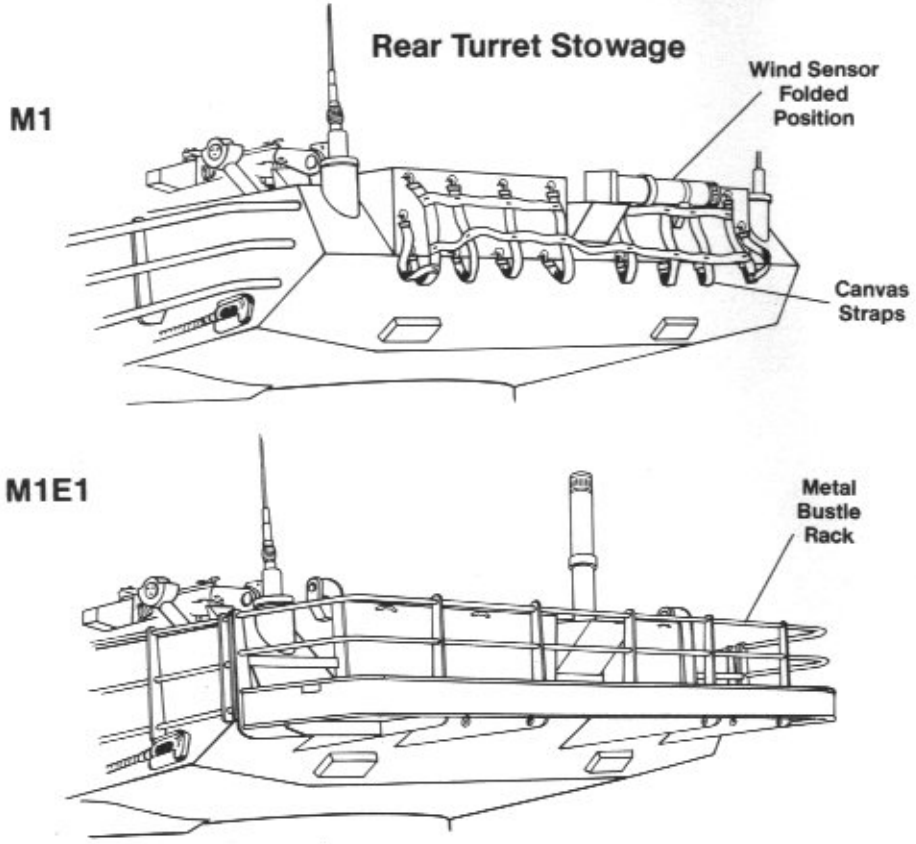
The M1E1 also tested a new stowage rack on the turret to replace the stowage straps used on the early M1 which had proved to be very unpopular with the crews. The rack ran the entire width of the turret and was hinged to fold upward to allow access to the engine deck. (Green)







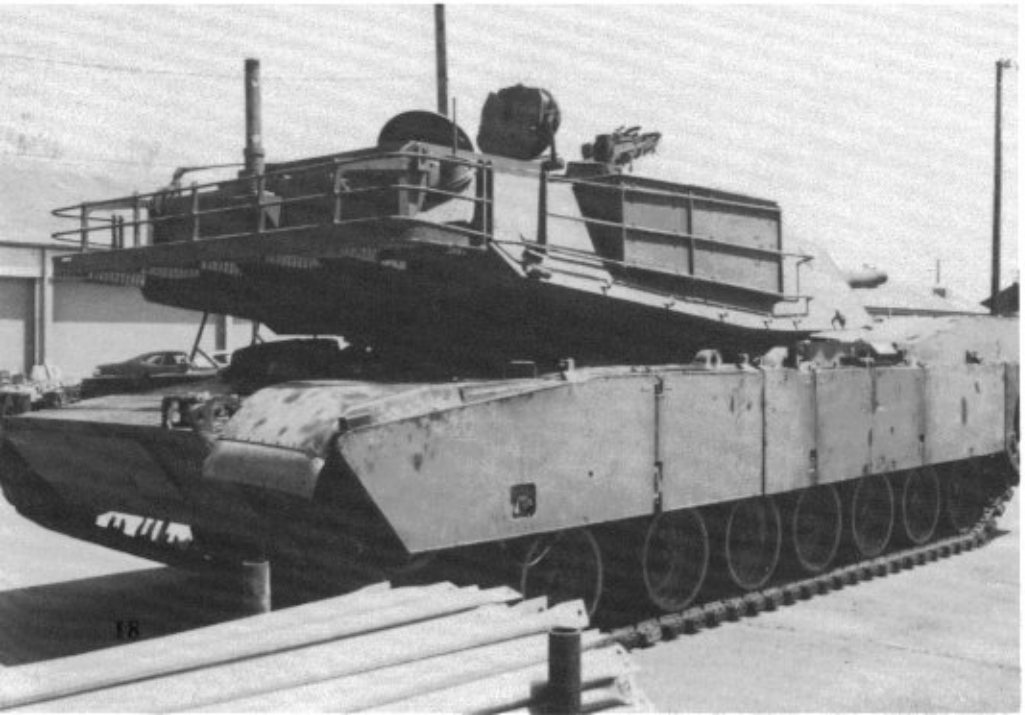
This early production M1E1 at Aberdeen Proving Grounds still has the three blast panel hatch on the turret roof. This configuration was later revised on late production models to two equal sized panels. (U.S. Army)



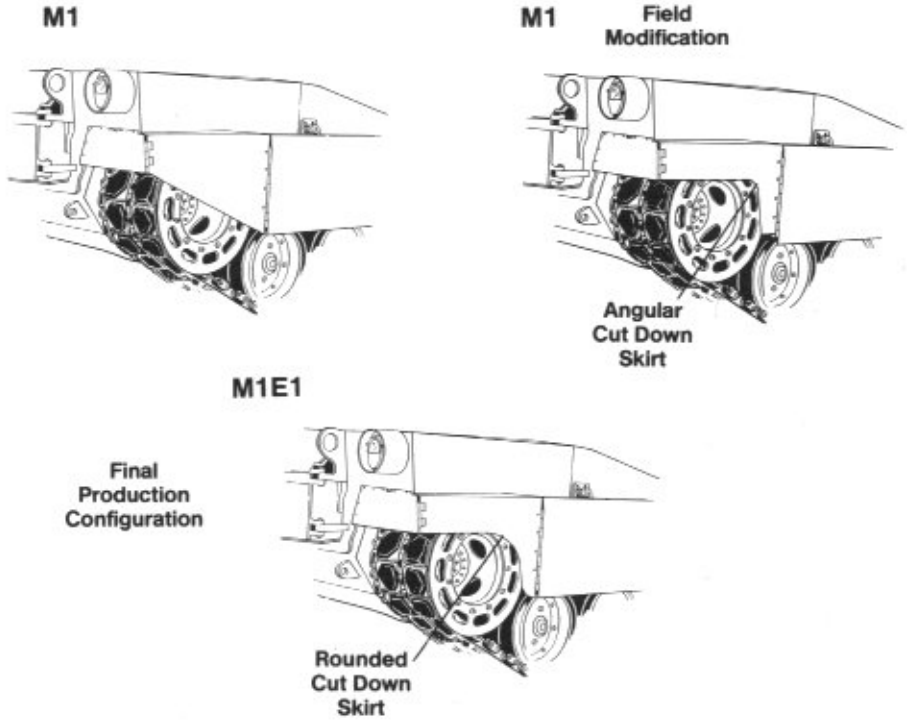
The new armor configuration under consideration would also add more protection to the hull. External armor plates were welded to the front of the hull to simulate the additional weight of the proposed change. (Green)

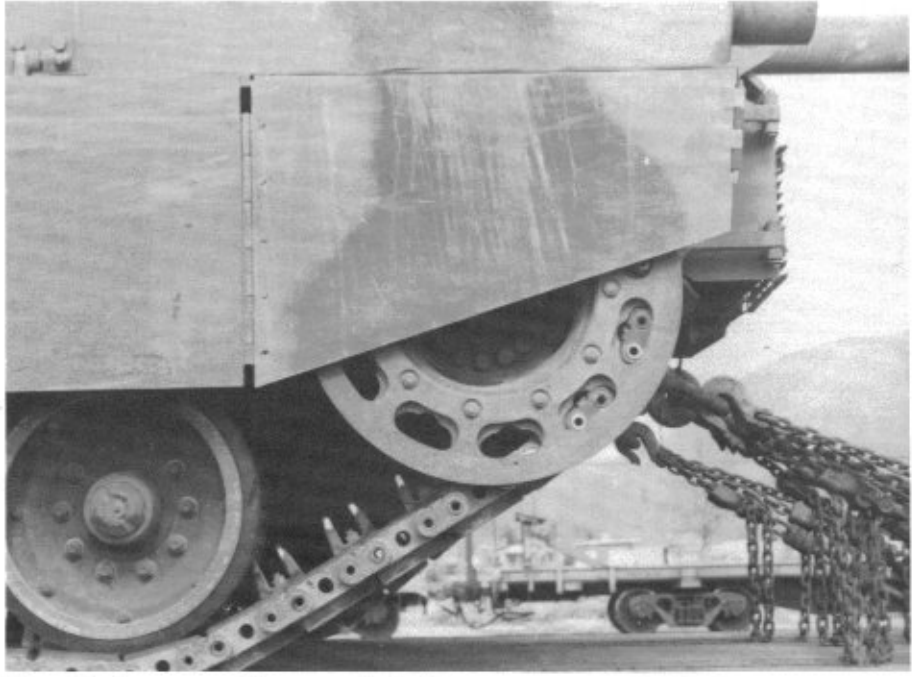
This Abrams has all the modifications tested on the M1E1; the 120MM main gun, extra armor plating on the turret and hull, rear turret bustle rack, cut down rear armor skirt, and additional side turret stowage bin. (Michael Green)

The original external stowage rack on the turret side had curved back into the turret side on early production M1s, while on the M1E1 it was extended back joining the rear turret rack. Additionally a second storage bin was added to the turret side. (Green)

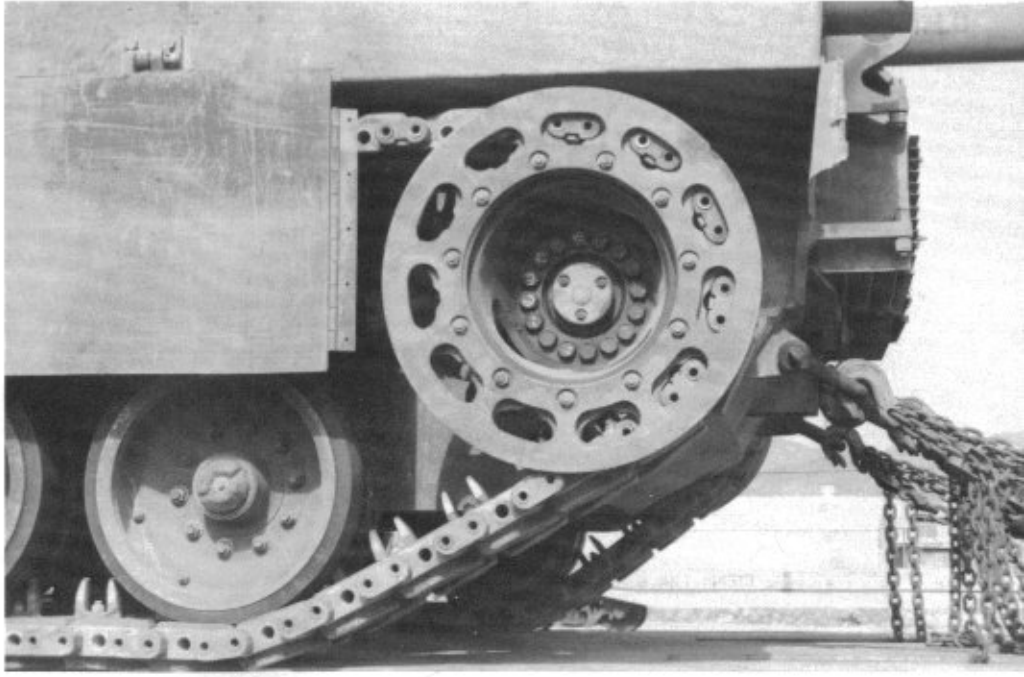


Rear Side Skirt Armor



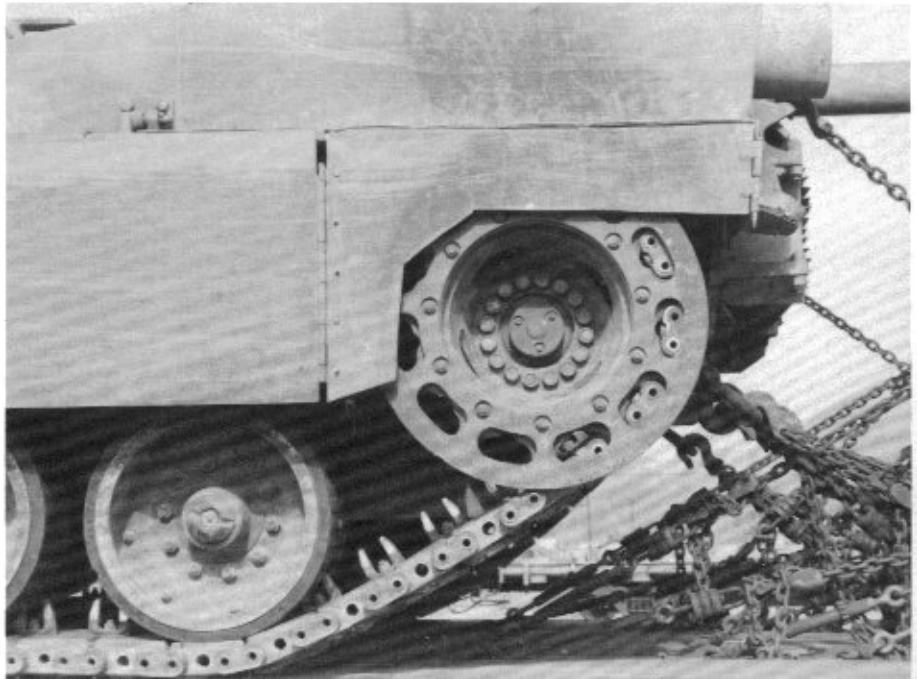


The original rear armor skirt covered half of the rear drive sprocket and allowed mud to build up between the hull, drive sprocket, and the armor skirt causing the M1 to throw tracks. (Stewart)

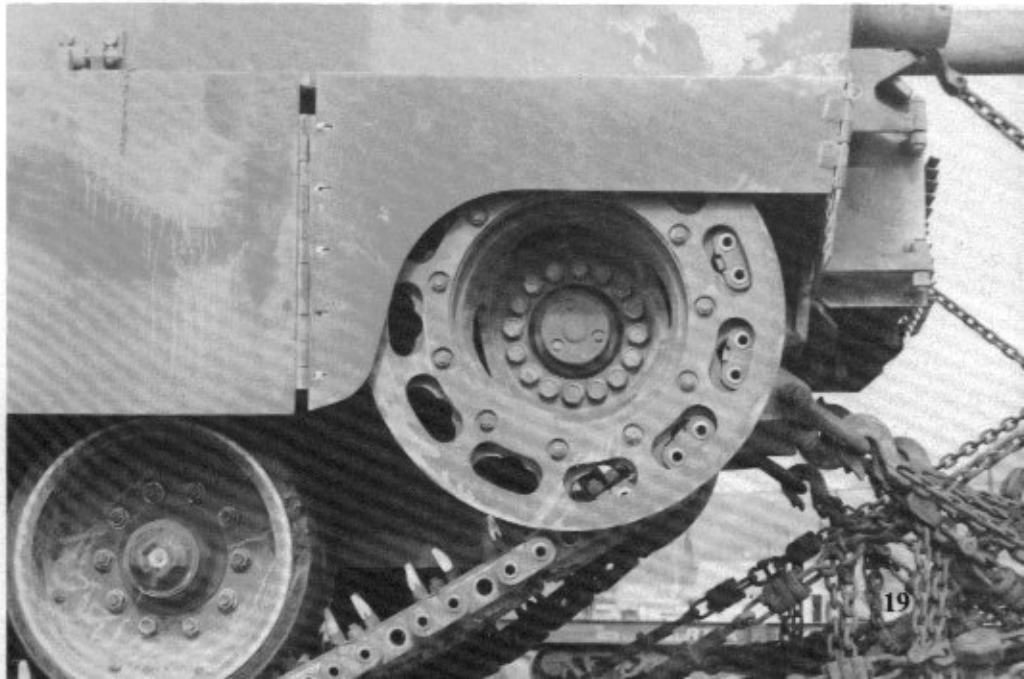


To alleviate the buildup of mud between the drive sprocket and the armored side skirt, a number of solutions were tried including the complete removal of the armored skirt opposite the drive sprocket. (Stewart)

Various field modifications were tested to solve the mud build up problem. This M1 was modified in the field with the skirt partially cut back to clear most of the drive sprocket and allow the sprocket to throw mud clear of the vehicle. (Stewart)



The final configuration, first used on the M1E1, featured a smoothly curved skirt which cleared most of the drive sprocket. This design allows mud to drop free before binding the drive. All production M1s are now fitted with this standardized style of rear side armor skirt. (Stewart)



IP M1

While the M1E1 test program was still in progress, the Army decided to take advantage of some, but not all, of the improvements which the M1E1 project had developed to upgrade the basic M1. The IP M1 was basically a production M1 upgraded with a number of internal and external improvements while retaining the M68 105MM gun. The IP M1 was intended to be an interim tank to keep production going until the M1E1 was ready for full scale production.

The most obvious external change was the addition of a bustle rack to the rear of the turret and an additional storage bin on the turret side, although a number of early production IP M1s were built without these improvements. A less noticeable modification was the increase in armor protection on the front of the hull and turret. The only noticeable difference between the IP M1 and the basic production M1 is a shortening of the distance between the gun bore evacuator and the mantlet. The turret was also improved internally, being fitted with a redesigned gun rotor.

To increase cross country performance and make the vehicle ride smoother, the suspension was strengthened by the addition of increased capacity shock absorbers and a reindexing of the torsion bars. Improvements were also incorporated in the transmission and a number of IP M1s were also fitted a Nuclear, Biological, Chemical (NBC) Warfare over-pressure ventilation system to protect the crews from Soviet advances in the chemical warfare field. Other improvements included the installation of the modified rear

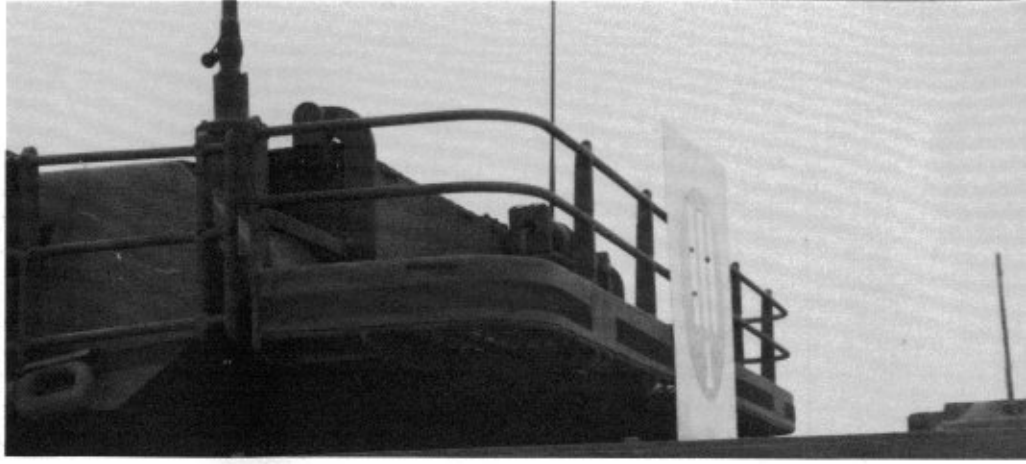
This IP M1 of 1/12 Cav carries the tank's identification number, 11 31, on the hull front and on the covers of the grenade launchers in Black. The IP M1 featured additional armor protection on the hull front and turret faces to increase ballistic protection for the crew. (Mesko)

The IP M1 also differed from the M1 in having a bustle rack on the rear of the turret for stowage of extra equipment and personal gear. A number of early production IP M1s did not have the bustle rack installed during production and were fitted with a field installed rack. (Mesko)

armor skirt panels that were first tested on the M1E1 and the addition of smoke grenade stowage boxes on the sides of the turret below the grenade launchers.

During trials with the IP M1 a number of vehicles were subjected to survivability test using live ordnance. Wherever possible the Abrams was tested against captured Soviet munitions, such as tank shells, RPG rockets, anti-tank missiles, mines, and artillery rounds. These tests revealed that the Abrams was one of the best protected armored vehicles in the world. Hits that would have destroyed an M60 caused no disabling damage to the Abrams. In test after test the Abrams was driven away after being hit by the same type of anti-tank weapon that would have killed the crew of an M60. M1 crews were shown films of these tests conducted with the XM1, M1E1 and IP M1 as part of their training, to impress upon them the great improvement in survivability enjoyed by the M1 over the M60. After Congress was briefed in closed door session on the results of these tests much of the earlier Congessional hostility toward the program was silenced.

All the various changes to the IP M1 increased the weight of the vehicle by about one ton over the basic M1 which resulted in a drop in top speed of 3.5 mph, a twenty-five percent decrease in slope speed, and a reduction in the cruising range of some ten miles. Production of the IP M1 began in October of 1984 and ran through May of 1986. During this period 894 IP M1s were produced, these being issued to tank battalions in both the US and Europe. A number of early production M1s have also been retrofitted with the turret bustle rack and stowage bins used on the IP M1s, however, there are no plans to increase their frontal armor protection at this time.



The factory installed version of the bustle rack extended the rack out to meet with the extended side stowage rails. A solid metal lip was also added to the lower portion of the rack to help keep gear in place. (Mesko)

The distance between the gun bore evacuator and mantlet is shorter on the IP M1 because of the addition of extra armor on the turret face, however, overall barrel length is actually unchanged. (Mesko)

The rear stowage rack is hinged to swing up and out of the way to allow the crew access to the engine deck. The Black strip along the metal lip is a velcro strip for attaching Multiple Integrated Laser Engagement System (MILES) laser training gear to the tank. (Mesko)

This early production IP M1 was modified in the field with a bustle rack which featured wire mesh to keep the crew's gear from falling out. The old style stowage straps were also used to keep gear from being bounced out of the basket when the tank ran over rough ground. (U.S. Army)

The M1 was subjected to a number of survivability tests with live ordnance to simulate actual battlefield conditions. In this test a captured Soviet mine is exploded under the hull. Test results showed that the M1 was one of the best protected vehicles in the world. (Green)

One of the most spectacular survivability tests was the explosion of an artillery shell directly over an M1 to test the thinner top armor. The shell was detonated above the turret electronically to determine how an airburst would affect the tank. (Green)

M1A1

The fourteen M1E1 vehicles gave the Army a chance to conduct a thorough evaluation of the 120MM gun and the overall performance of the vehicle with the added weight of the increased armor protection. when the field and operational trials had ended, the Army had accumulated all the data necessary to formalize the final production configuration of the vehicle which was initially to retain the designation of M1E1. Before production actually began, however, the designation was changed to M1A1.

The major difference between the M1 and M1A1 was the replacement of the M68 105MM rifled cannon with the M256 120MM smoothbore cannon. The armor configuration tested on the M1E1 was adopted for the M1A1 and production vehicles leaving the factory had thicker armor on the lower hull front and turret faces. Other improvements included an improved rear turret bustle rack, larger turret side stowage bins, transmission and suspension improvements, an NBC overpressure system, standardized rear armor skirt plates, a new style crosswind sensor, revised headlights and headlight guards, a new gunner's sight housing, and deletion of the track guards on the drive sprockets.

Internal changes included revised sight optics and secondary gunnery systems associated with the new main gun, revamped ammunition storage bins in the turret to accommodate the wider 120MM rounds, and a different seating arrangement for the tank commander and loader which was necessary because of the revised ammunition storage. Initially the original arrangement of three blowout panels on the turret roof was retained, however, on later production M1A1s this was changed to a two panel configuration where the panels are of equal size.

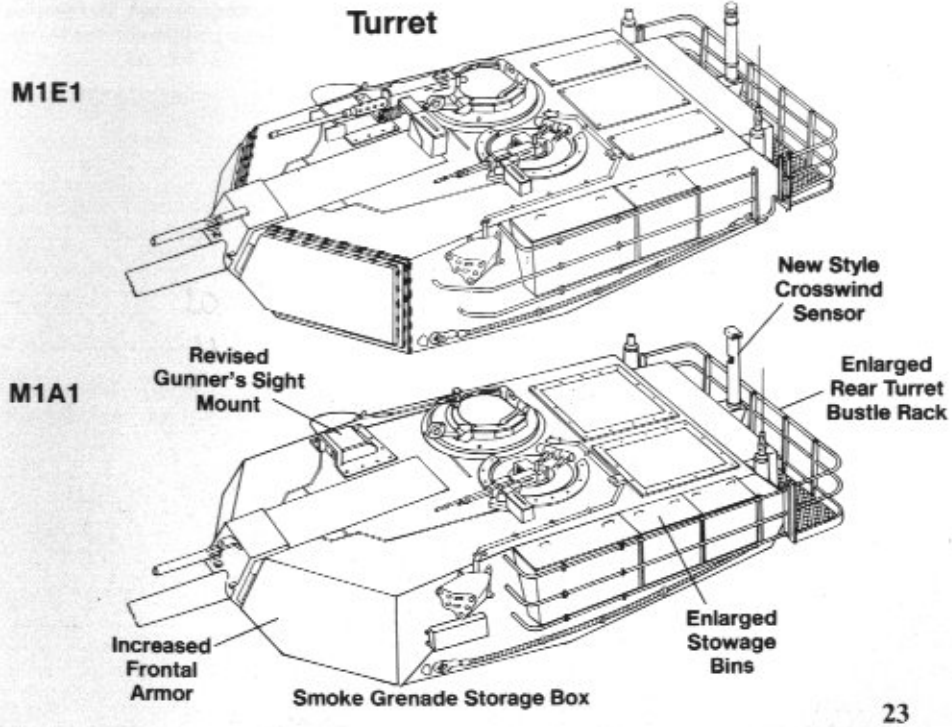
These changes increased the weight of the M1A1 which caused speed and range to drop slightly. This loss of performance had been shown in the M1E1, however, the Army felt that it was more then offset by the better crew protection offered by the additional armor and the increased fire power of the larger caliber main gun. Unfortunately, the wider diameter of the 120MM rounds has resulted in a reduction of the ready ammunition from fifty-five rounds to forty rounds. Some Army officials have expressed concern that this reduction could pose serious problems in a prolonged tank battle if the M1A1 was unable to pull back to resupply its ammunition.

Current plans call for the procurement of 4199 M1A1s. During 1988 the Army announced additional improvements that will be incorporated into the basic M1A1 during the Block II Production Improvement Program (PIP). A major change under the Block II PIP is the installation of a Commander's Independent Thermal Viewing system (CITV). This will give the tank commander a sighting system which is completely independent of the gunner's system, allowing him to track and identify targets while the gunner is engaged with another target.

Additionally, other new systems may be installed during the Block II PIP, such as an automatic target designator system, an Identification Friend or Foe (IFF) system (similar to that used on aircraft), a computerized Battlefield Management System (BMS), eye safe CO2 laser range finders, an independent thermal viewer for the driver, and a fast refueling capability. Some or all of these may be added to the M1A1 as they are cleared for production. If all of these systems are added to the M1A1 it may lead to the vehicle being redesigned the M1A2, however, the Army has not yet announced that it plans any such change in the Abrams' designation.

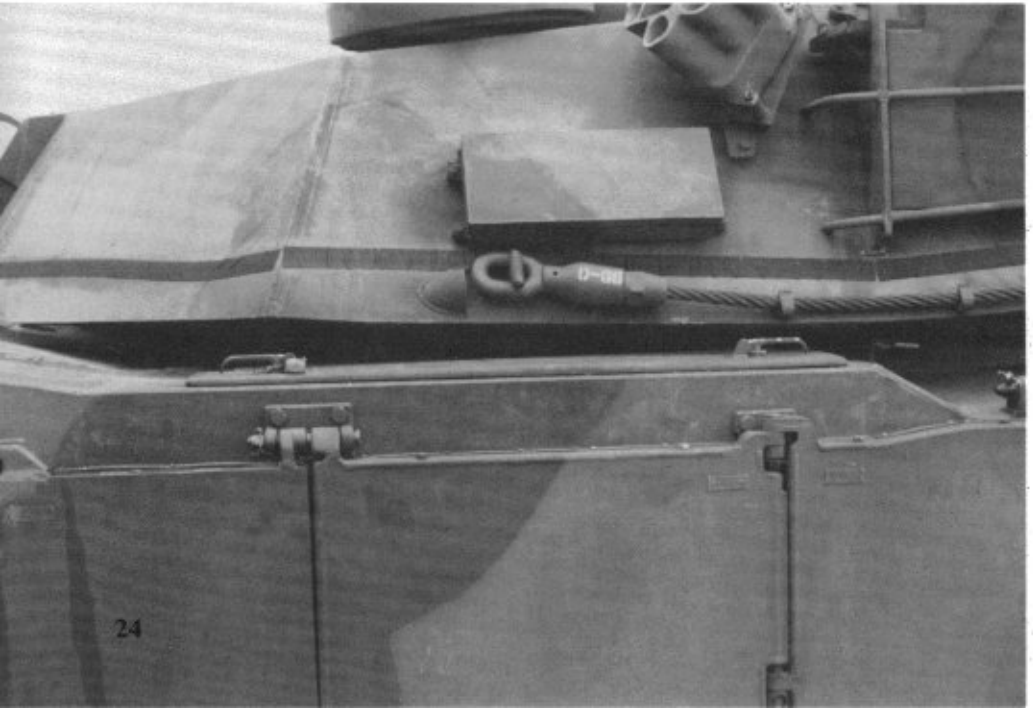
Reportedly, the Army is considering updating the armor protection of the M1A1 by reinforcing the hull in selected areas with an armor mesh made of depleted uranium. This depleted uranium mesh is two and one half times as dense as a similar mesh made of steel and would provide greater protection against current Soviet anti-tank weapons, especially shaped charge anti-tank missile warheads. The entire project is classified in regards to the amount of uranium mesh to be incorporated, where it will be located, and the exact way the mesh will be manufactured. It is known, however, that the Army is planning on fitting all remaining M1A1s on the current production contract (approximately 3,000) with the mesh while they are still on the production line. Current Army planning calls for these improved M1A1s to be allocated to units based in Europe opposite the main Warsaw Pact armor threat. At the present time there are no announced plans to retrofit the uranium mesh armor to M1A1s already in service.

This early production M1A1 was delivered to the Army at Fort Knox for evaluation by the Armor Board during 1985. It incorporated many of the modifications which had been tested on the M1E1, some of which had already been incorporated in the IP M1 series. (Mesko)

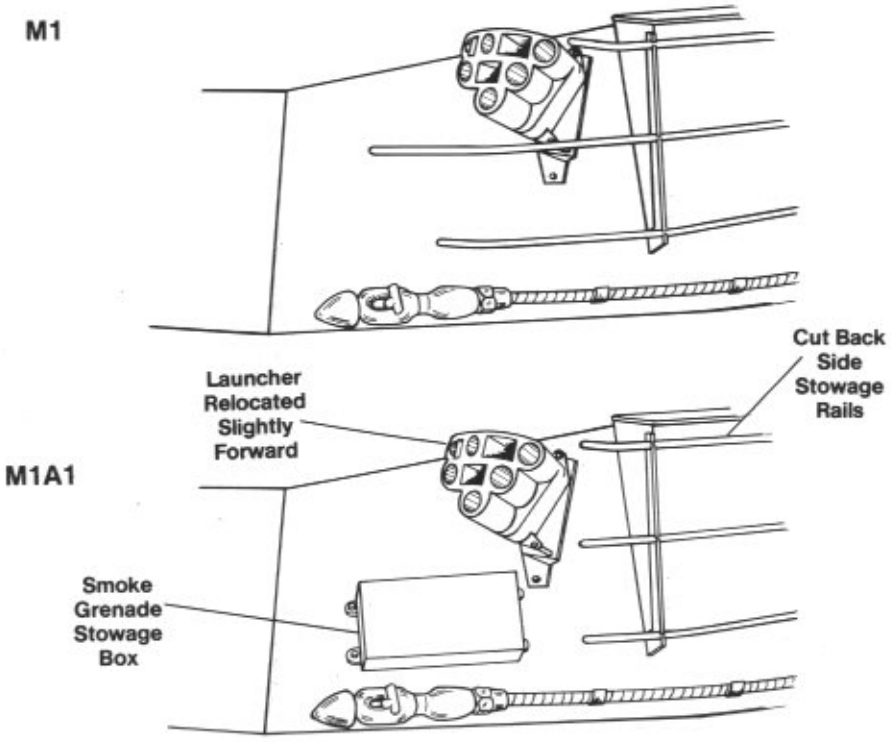


The 120MM gun on the M1A1 features a more rounded bore evacuator than the earlier 105MM gun used on the M1. The side turret stowage boxes are also larger to provide the crew with additional stowage space. (U.S. Army)

The box above the cable attachment point is a storage box for smoke grenades. The grenade launchers themselves have been relocated slightly forward of their position on the M1 and the stowage racks have been cut back in length. (Jerchel)



Smoke Grenade Launcher/Stowage Box



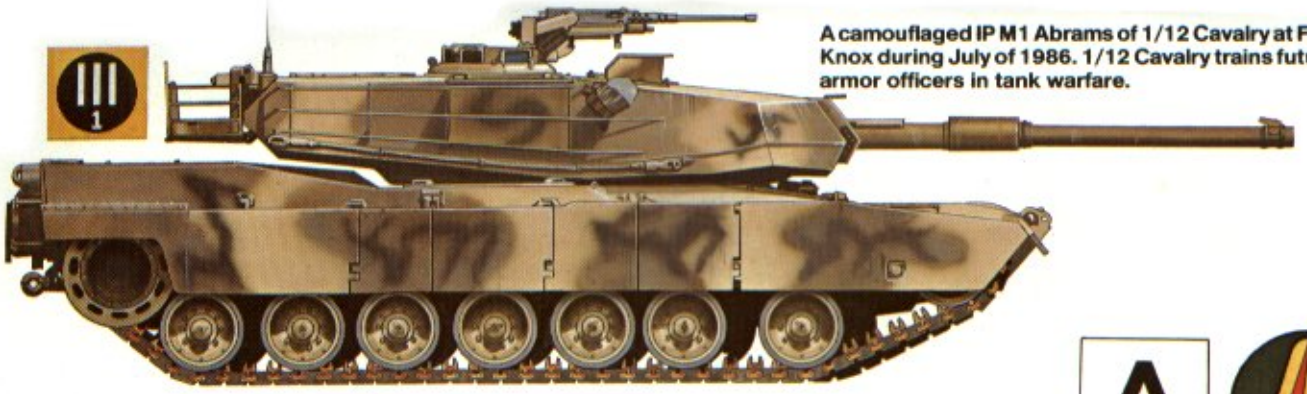
An overall Forest Green M1 Abrams of 2/64 Cavalry, 3rd Infantry (Mechanized) Division during the annual NATO exercise *Reforger '82* held in September of 1982.

A camouflaged M1 of the 2nd Battalion, 67th Armor, 2nd Armored Division at Fort Hood, Texas during July of 1983.

This M1 Abrams of the 3rd Battalion, 67th Armor, 2nd Armored Division at Fort Hood carries a Black Wolf's head on the armor side skirts in Black.

This M1 of the 11th Armored Cavalry was part of the "Blue" army during the NATO exercise *Reforger '83* held in Germany during the Fall of 1983.

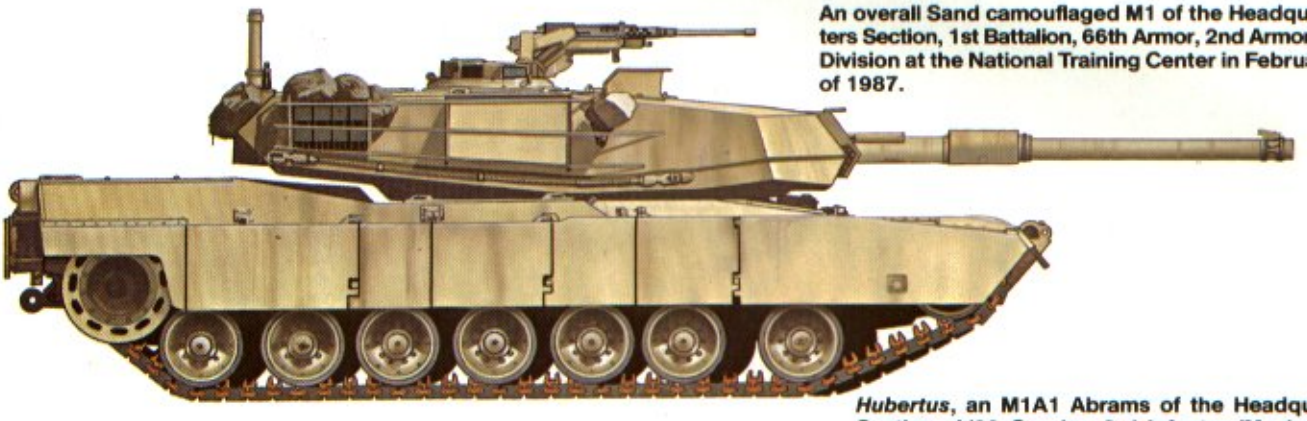
This overall Forest Green M1 of 1/64 Cavalry, the "Bandits" of the 3rd Infantry (Mechanized) Division, carries the unit insignia on the turret face in Black.



A camouflaged IP M1 Abrams of 1/12 Cavalry at Fort Knox during July of 1986. 1/12 Cavalry trains future armor officers in tank warfare.

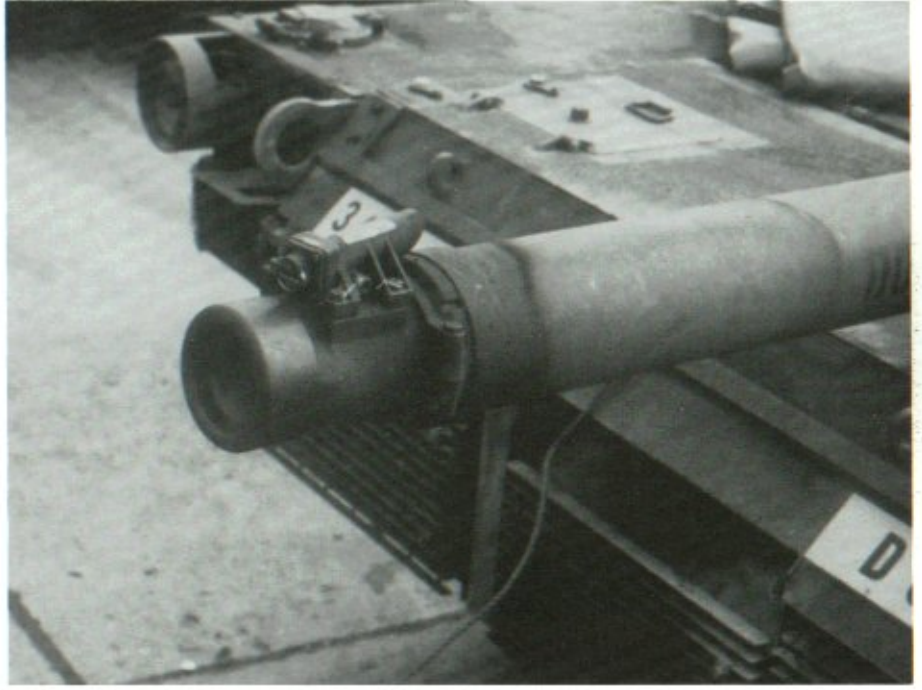
Danger Zone an IP M1 of Delta Company, 4th Battalion, 8th Cavalry, 2nd Brigade, 3rd Armored Division during the Canadian Army Trophy competition held in Germany during July of 1987.

BAD ARMADILLO an M1 of B Company, 3rd Battalion, 32nd Armor, 1st Cavalry at the National Training Center in February of 1987.

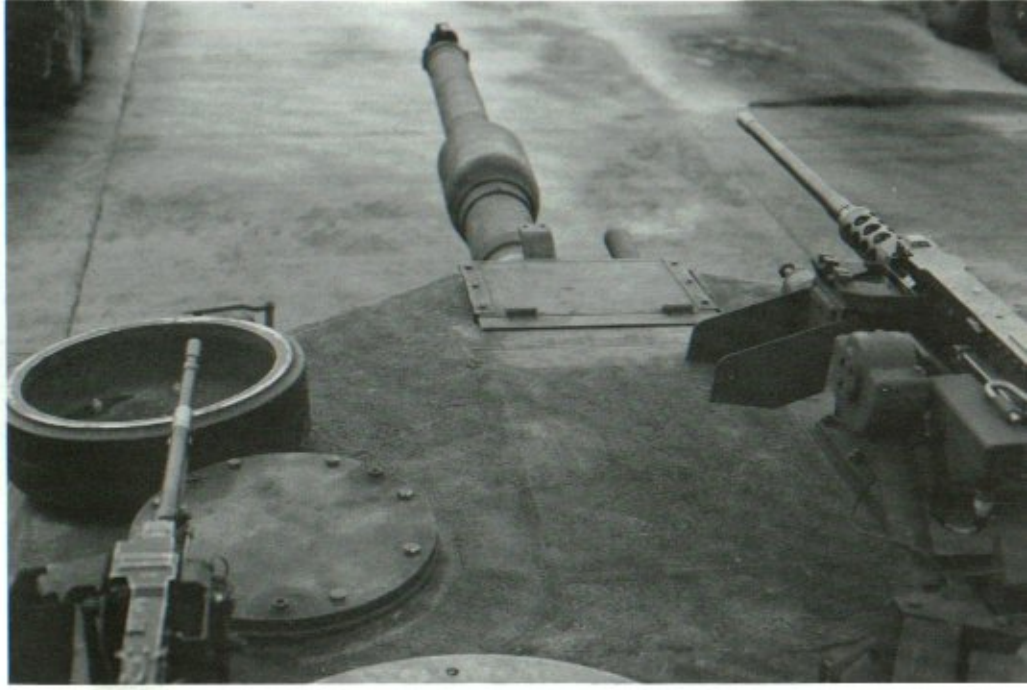


An overall Sand camouflaged M1 of the Headquarters Section, 1st Battalion, 66th Armor, 2nd Armored Division at the National Training Center in February of 1987.

Hubertus, an M1A1 Abrams of the Headquarters Section, 4/66 Cavalry, 3rd Infantry (Mechanized) Division in Germany during August of 1987, is camouflaged with the new chemical resistant camouflage paints.



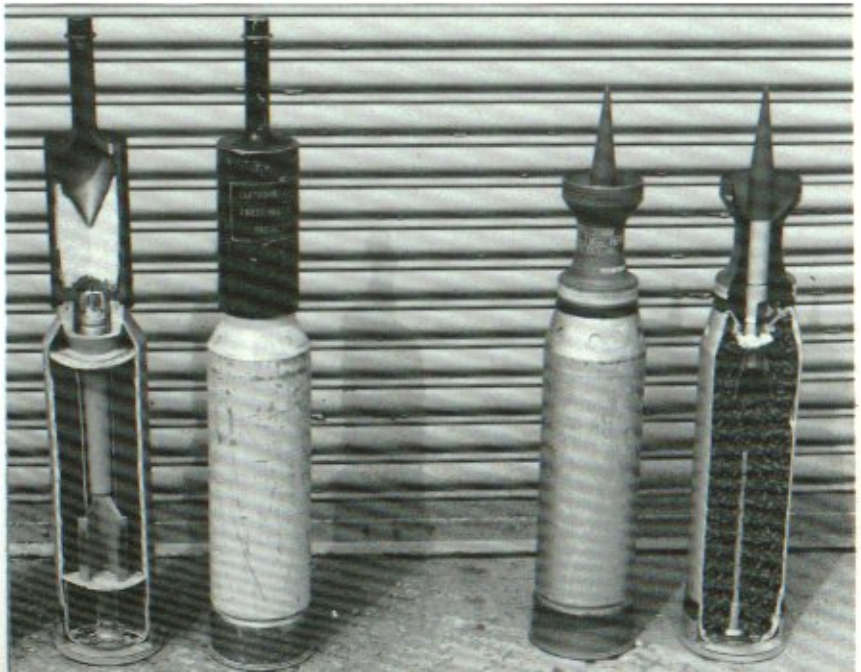
The mount for the Muzzle Reference System on the M1A1 differs from the M1 mount being slightly larger because of the size difference in the barrels of the M68 105MM gun and the German 120MM gun. (Sewell)

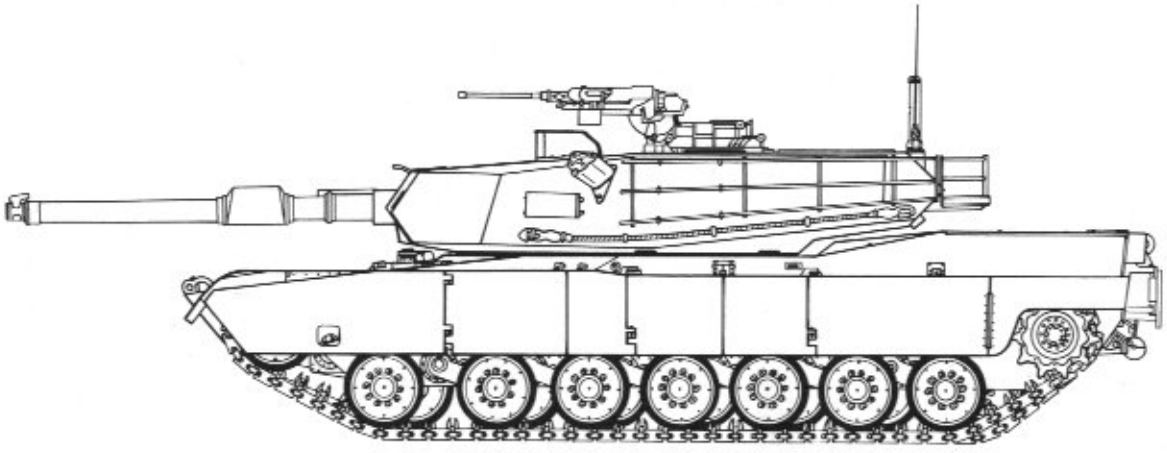


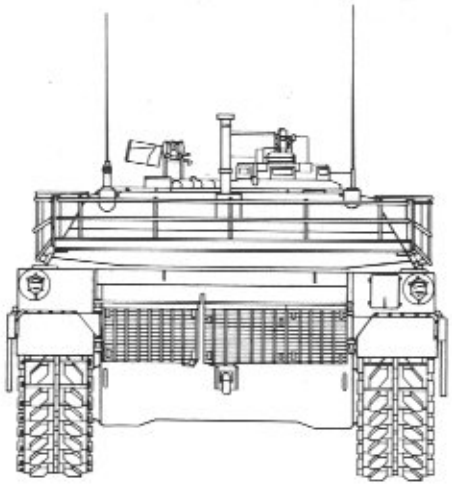
On late production M1A1s there is a circular fitting on the turret roof which will be used for additional sighting equipment planned for installation on the vehicle at a future date. Just forward of this fitting is a spare road wheel. (Jerchel)

These shells and their cutaway counterparts are used for classroom instruction for M1 crews. The shell on the left is the M830 HEAT-T while the round on the right is the M865 TPFSDS-T. The M830 is a standard round carried on the M1 while the M865 is a training round. (Mesko)

The headlight guards on the M1A1 differ from the M1 being flatter and slanted slightly forward. These revised guards also have a slight dip on the top and have only one attachment bolt. (Jerchel)

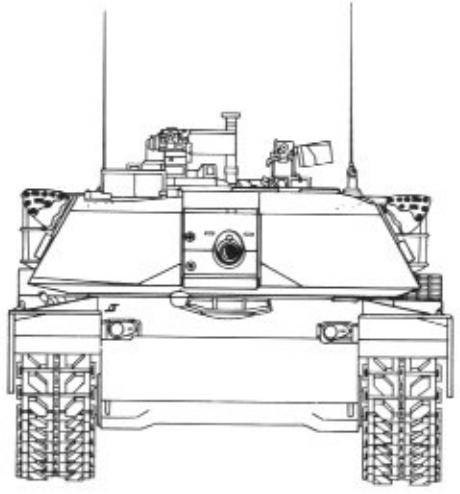


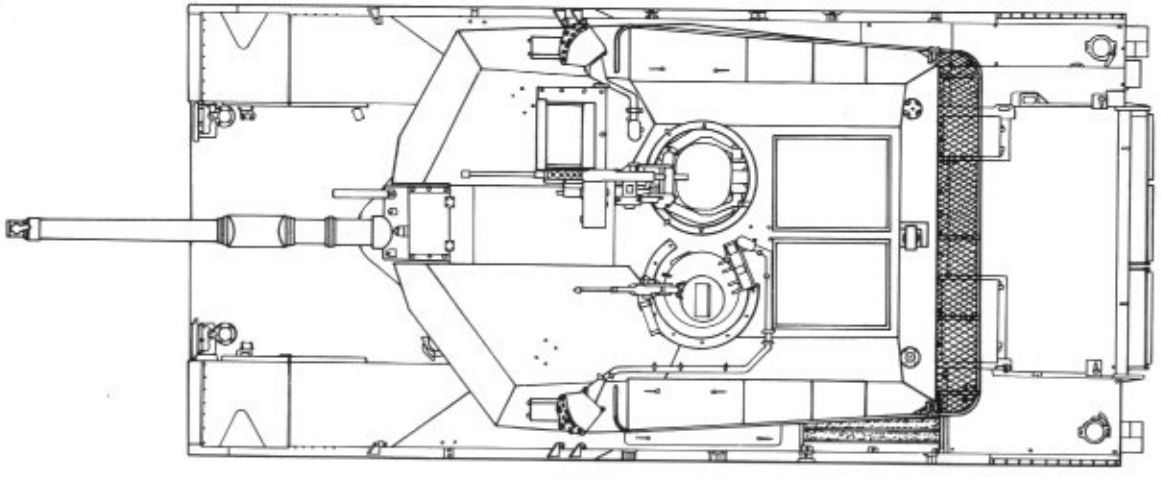




Specifications
M1A1 Abrams

Length	32 feet 3 inches
Height	7 feet 9 inches
Width	12 feet
Maximum Weight	63 tons
Powerplant	One 1,500 hp Avco-Lycoming turbine engine
Armament	
Main:	M256 120MM smoothbore cannon
Secondary:	One .50 caliber machine gun Two 7.62MM machine guns.
Performance	
Maximum Speed	42 mph
Range	265 miles
Crew	Four

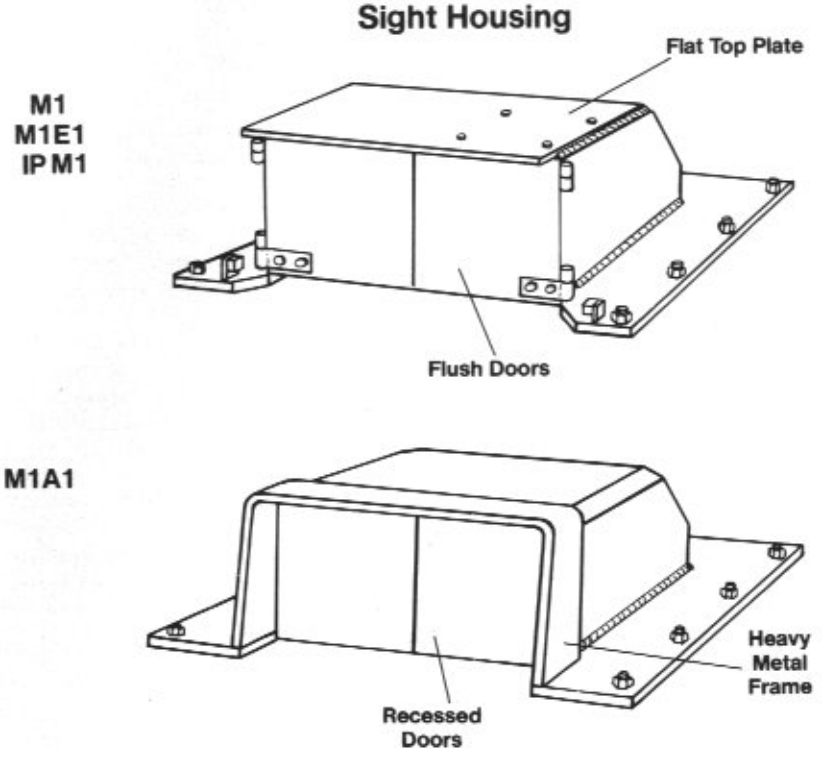




The twenty-five inch track retainer plate over the drive sprocket was deleted on the M1A1 and the rear armored side skirting was modified to help cut down on the buildup of mud and debris around the drive sprocket. (Jerchel)

Production M1A1s feature the final blast panel configuration which consists of two equal sized turret blast panels in place of the earlier three panel configuration used on the M1. The wind sensor post has also been changed and now has a slimmer shape. (Jerchel)

The gunners sight aperture on the M1A1 has been modified to handle upgraded optics. The armored doors on the front of the sight are now recessed and protected by a heavy metal lip. The doors swing outward when the sight is in use. (Sewell)



Into Service

Early production of the M1 was limited in order to incorporate changes to production vehicles that were dictated by experience gained during the initial service use of the Abrams. The first Army units to receive the Abrams were units of the 1st Cavalry and 2nd Armored Division during mid-1981. As these units completed their work-ups with the M1, they submitted detailed reports of the problems encountered during service introduction and made recommendations for corrective action. This procedure resulted in a smooth service introduction and by the end of 1981, the DOD had given approval for full scale M1 production. That fall, the first M1s made their debut in Europe when elements of the 3rd Infantry Division (Mechanized) in Germany began to re-equip with the Abrams.

Despite the extensive field testing done by these units, the Army was anxious to deploy M1 battalions in the annual NATO wargames to demonstrate the Abrams' performance under near combat conditions. During the Fall of 1982 the 64th Armor, 3rd Infantry was slated to take part in the annual NATO *Reforger* exercise as part of the 'Blue' Army. This exercise would be the first real 'combat' test of the M1 and of the supporting elements that would maintain the vehicles in the field.

On 13 September 1982 the exercise began and elements of the 64th Armor were quick to gain the advantage. Opposed mainly by Canadian Challenger and Leopard I tanks, the tankers of the 64th Armor used the Abrams with telling effect against the 'Orange' forces. The M1's speed totally surprised their opponents, who were stunned by the Abrams' ability to seemingly appear out of nowhere, firing on the move. The quiet operation of the turbine engine let Abrams crews approach enemy forces undetected and allowed them to achieve an element of surprise. The Canadian tankers quickly gave the Abrams the nickname, *Whispering Death* for its ability to move quietly and strike with surprising speed.

By the end of the exercise the Abrams was, without a doubt, the supreme ruler of the battlefield. The American tankers had developed and employed tactics that used all the M1s strong points to dominate the exercise and had shown how remarkable a vehicle the Abrams actually was. This hard evidence went a long way toward silencing skeptics of the program both in Congress and within the Army itself, however, the press still criticized the program for its high costs.

As Abrams production gradually climbed from thirty to seventy vehicles a month, additional Armor units began re-equipping with the M1. Units at Fort Hood, Fort Bragg, and Fort Knox began receiving M1s, as did a number of units in Europe. Units began receiving the IP M1 during December of 1984 and during early 1986 the first M1A1s started rolling off the production line for delivery to first line units. Among the first units to receive the improved M1A1 was the 2nd Armored Division at Fort Hood, Texas. As M1A1 production increases, additional units will exchange their M1s for M1A1s.

Early Army planning called for the production of some 7,000 M1s, however, the Army is attempting to increase this figure by approximately 5,000 additional vehicles. These M1s will be issued to the National Guard and Army Reserve to replace their M60s after all regular forces are re-equipped.

When the Abrams was introduced into service, the Army also underwent a reorganization of the basic Armored Division. Under the "Div-86" concept, the revised Armored Battalion now consists of fifty-eight M1s as compared with fifty-four M60s that had equipped the earlier style armored battalion. The new organization realigns the battalion into four tank companies with three platoons instead of the three companies and three platoons of an M60 battalion. The new platoon organization has a strength of four tanks (five for an M60 platoon) which operate in pairs for mutual support. The battalion also has an organic M3 Bradley scout platoon.

This reorganization came about as a result of new tactics that were adopted because of the performance and capabilities of the M1. These tactics stress the use of combat pairs of M1s that support each other much like the tactics used by an aircraft fighter squadron. The basic combat formation is quite similar to a fighter aircraft 'finger-four' formation, with a leader and 'wingman.' The leader attacks the target while his partner provides covering fire. When operating as a platoon, one pair of M1s move forward to engage, while the second pair remain in a hull down position to provide support and covering fire. In the advance, a Combat Wedge formation is used where the inner pair of tanks (Platoon Leader and Platoon Sergeant) engage targets to the front while the outer two tanks (Number Two and Four) engage targets on either flank.

During the Summer of 1987 the M1 took part in the bi-annual Canadian Army Trophy (CAT) competition held in Germany. This gunnery competition determines the top NATO Army Group and top gun tank platoon. The first competition was held during 1963 and in the ensuing years the United States had never won the trophy. Teams competiting in the 1987 contest were armored units from the British, Belgian, Dutch, German, Canadian, and U.S. armored forces. Throughout the week long contest each team worked hard to score the highest possible number of points in this friendly but deadly serious shoot-off. Going into the last day of the contest, the German 124th Panzer Battalion had a commanding lead and seemed to have the trophy securely won. All that stood in their way was the 1st Platoon, D Company, of the 4th Battalion, 8th Cavalry mounted in IP M1s. Working flawlessly, the American tankers hit target after target until the Germans realized that their seemingly safe victory was in jeopardy. At the end of the day the final tabulation showed that the 1st Platoon had scored an impressive 20,490 points, beating the Germans by 800 points. Another M1 platoon had the third highest score, while an M1 company had won the team high score. Any lingering doubts about the M1's capabilities were put to rest with this impressive showing.

An M1 Abrams of the 1st Cavalry Division at Fort Hood, Texas takes shelter behind a dozed out position. The 1st Cav was the first unit to receive the M1 and conducted operational trials during 1981. Although some problems were encountered, none were serious and the vehicle's service introduction was reasonably smooth. (Green)

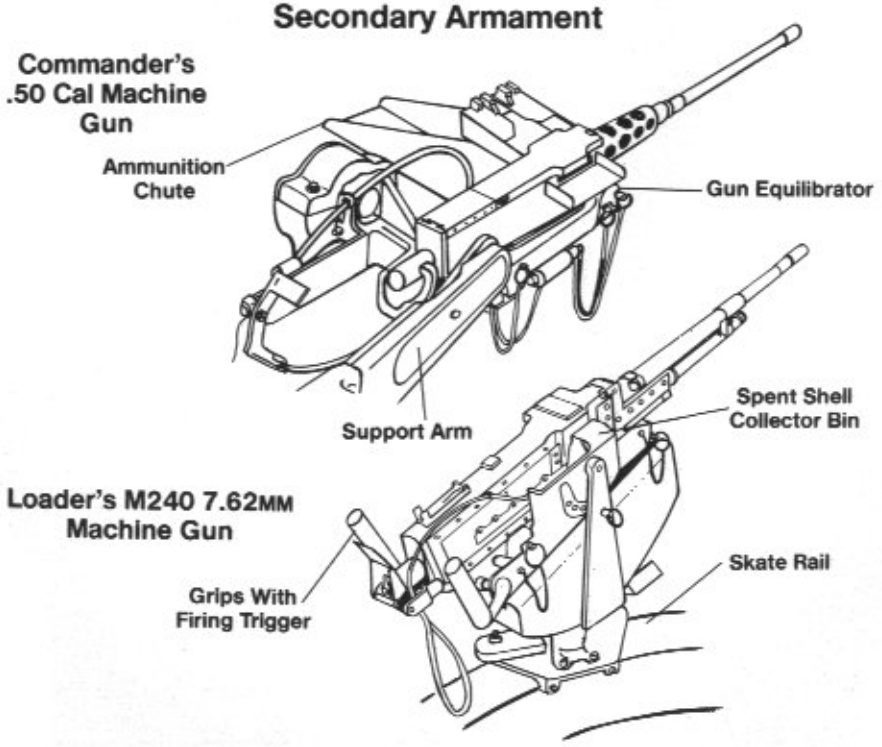
Marine Corps M1

The Marine Corps has also announced that it will purchase the M1A1 to replace its aging fleet of M60s. Initially some concern had been raised about the effects of salt water on the engine, however, after reviewing the M1's engine layout it was felt the problem would be relatively minor. The major difference between the Army and Marine M1A1 variants will be the provision for wading gear on the Marine Corps Abrams. The wading kit will include a muzzle cap for the gun, an engine exhaust tower, and two engine air intake towers mounted alongside the turret. The wading kit will allow the M1 to ford a depth of up to two meters (six and one half feet). The intake and exhaust towers can be removed once the tank is ashore by simply traversing the turret. The first Marine Abrams are expected to be delivered during late 1988 or early 1989.

Foreign Service

Although the M1 has yet to become operational with any foreign nation, negotiations are ongoing with a number of potential foreign users. During 1983 two M1s and crews from the 2nd Armored Division deployed to Saudi Arabia to demonstrate the Abrams to the Saudi government. The Israel Defense Force has also expressed a desire to have the M1 demonstrated for possible use by their Southern Command in the Sinai Peninsula.

An agreement has been reached with Egypt under which the Egyptians will build the M1 in Egypt under license. This M1 variant will be an export version with certain features and items of equipment deleted for security reasons.



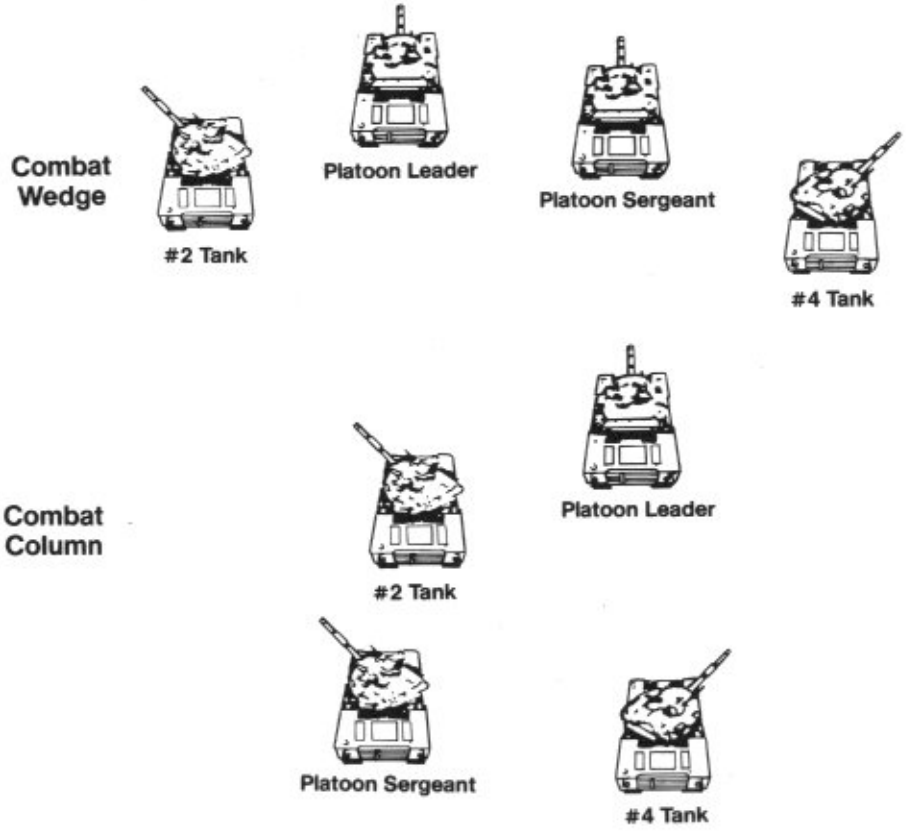
An M1 crewman confers with an infantry officer during a tactical exercise at Fort Hood, Texas. The M1 carries one of the early camouflage schemes which followed no official guidelines as to the pattern applied and varied from vehicle to vehicle. (Green)

The first unit in Europe to re-equip with the M1 was the 64th Armor, 3rd Infantry Division (Mechanized) which received their new tanks during the Fall of 1981. This M1 is enroute to the Grafenwoehr training range during February of 1982. (U.S. Army)

This M1 of the 3rd Division moves out cross country at high speed during a field training exercise. The M1's high speed and its ability to shoot accurately while on the move were well received by Abrams crews. (Green)

An M1 of the 1/64th Cavalry, 3rd Infantry Division (Mechanized) is parked alongside its Cavalry stablemate, the M3 Bradley. The Bradley was designed to give the infantry an armored personnel carrier which had an operating speed similar to that of the M1. (Green)

M1 Combat Formations



An M1 pulls into a refueling and recovery point during the *REFORGER 82* exercise. *REFORGER 82* was the first real operational test for the Abrams and throughout the exercise the M1 dominated the battlefield, more than living up to the expectations of the Army. (U.S. Army)

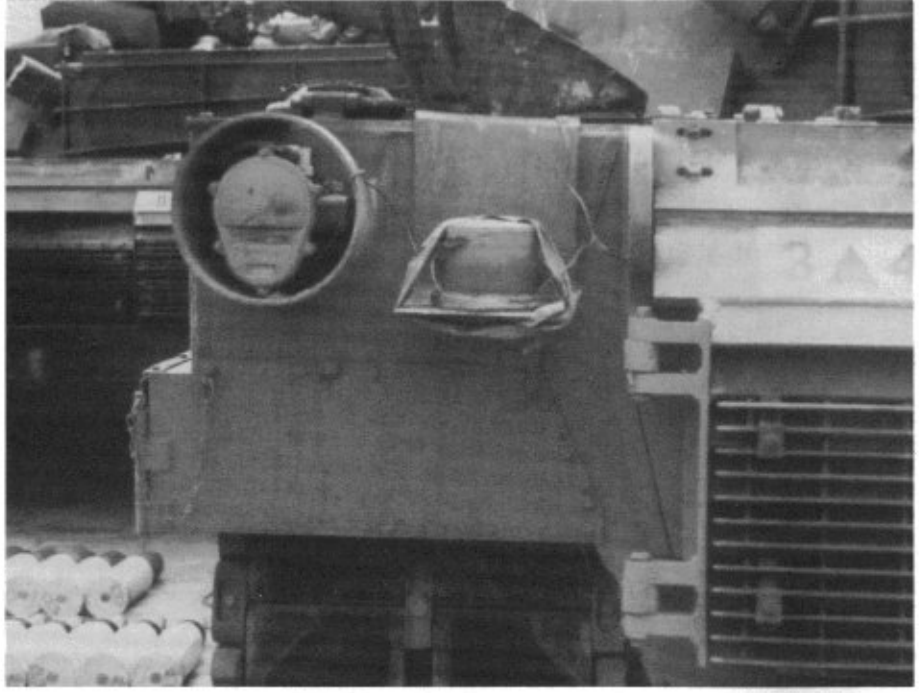
An M1 of the 64th Armor on a German road between *Grafenwoehr* and *Hohenfels* during February of 1982. When traveling on roads the turret is normally traversed to the rear and the gun barrel is locked in position. (U.S. Army)

A platoon of early production M1s prepare to move up on a firing range in Germany. Crew training on the M1 went smoothly with no unpleasant surprises for the tankers, thanks to the extensive testing which had been done with the prototype and trials vehicles. (Maple via Green)

(Below) M1s moving cross country at high speeds can create a large dust cloud. The M1 can also create a deliberate smoke screen by using its grenade launchers and engine smoke generator when under enemy fire. (U.S. Army)

(Above) Early production M1s left the factory in multi-tone camouflage, however, as production began to gear up, the M1s rolled off the assembly line in overall Forest Green. This 3rd Infantry Abrams has a large personal insignia painted on the turret, and carries unit identification markings on the lower hull front. (Green)

German villagers are quite accustomed to seeing tanks clanking through their quiet towns during annual fall NATO maneuvers. The tankers of these M1s must be careful since any damage done to civilian property must be paid for by the unit's government. (U.S. Army via Armor Magazine)



When M1s travel on German roads they are required to use anti-collision lights by German law. These lights called *Bubblegum Machines, Slop Jars*, or *Whoopee Lights* are mounted on removeable brackets on the rear hull plate next to the normal tail lights. (Sewell)

This M1 is moving along a dirt road up to its firing position on the practice range. The front suspension has shifted upward as the tank moves over the uneven road surface.

This M1 is parked alongside a German road while the tank commander checks his maps. The interior is cramped, leaving little room for the crew to stow personal gear and external stowage of extra gear is a common sight when a tank is in the field. (U.S. Army via Armor Magazine)

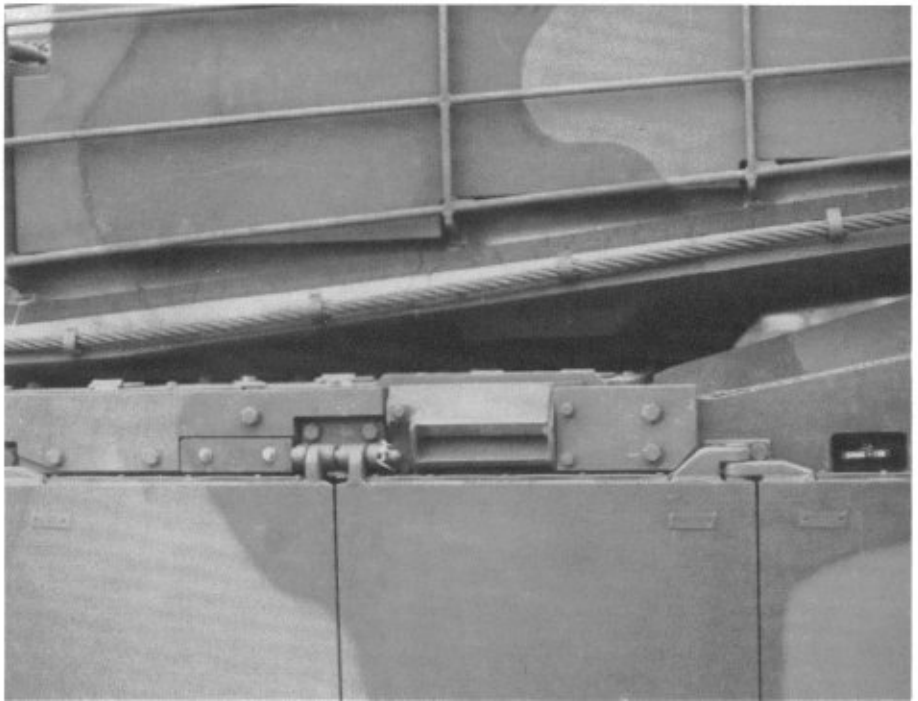
Tankers of the 1st Cavalry rest on their M1s as the tank commander studies the area through his field glasses during exercise *Certain Strike* in September of 1987. Units tasked with assignment to Europe in case of war often train in Europe using prepositioned tanks. These M1s are maintained by a cadre and are combat ready at all times. (Jerchel)

The Abrams has proven relatively trouble free in the field. When problems have occurred they have been handled quickly by repair crews. The crew of this M88 recovery vehicle helps pull the engine pack on *Birth Control*, an M1 from the 2nd Armored Division during exercise *Certain Strike*. (Jerchel)

Changing a power pack on the Abrams can be done in the field in about an hour, enabling the tank to quickly return to action. This is a dramatic improvement compared to the four hours needed to replace an M60 engine. (Jerchel)

Production M1A1s began arriving in Europe during the Summer of 1986 carrying a new three tone Forest Green, Red Brown, and Black camouflage scheme in a special chemical resistant paint. (Jerchel)

The M1A1 is equipped with an NBC air filter system which occupies the position formerly used for the left sponson storage box on the M1. The handle to the right of the filter housing is an external activating handle for the engine fire extinguisher and is in Red. (Jerchel)



M1A1s on the firing range in Germany await instructions to move up to the firing line. The vehicle in the foreground is the new M977 Heavy Expanded Mobility Tactical Truck (HEMTT) which has the speed to keep up with the M1 and is far safer than the M520 GOER which had been used to resupply tank units in the field. (Jerchel)

Tankers unload practice rounds from a M977 HEMIT. Each pallet of ammunition has thirty rounds on it and the M977 can carry a total of eight pallets (240 rounds), enough to supply six M1s with a basic combat ammunition load. (Jerchel)

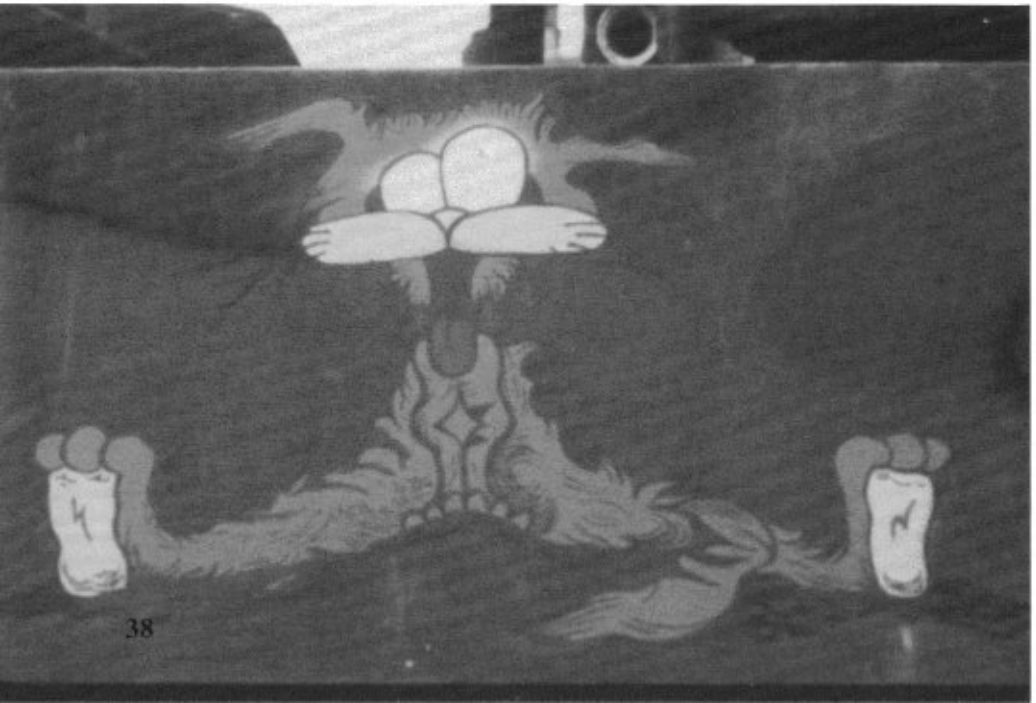
Despite the new stowage rack and extra storage bins on the M1A1, crews still add extra stowage, in this case ammunition packing tubes which are often attached to the rails with tape for stowing personal gear or items which need protection from the elements. (Jerchel)

M1A1 Abrams tanks of the 3rd Infantry Division move across a field in Germany during exercise *Reforger 88*. The vehicles are painted in a three tone camouflage scheme recently adopted by both the US and German armies. (Green)

In June of 1987 the 1st Platoon, Delta Company, 4th Battalion, 8th Cavalry, of the 3rd Armored Division won the Canadian Army Trophy by 800 points over its closest competitor. The unit's Abrams were specially marked for the competition with the 3rd AD patch and Bloom County's "Bill the Cat" cartoon character on the turret. (Sewell)

A number of early production M1s in Europe have been retrofitted with a bustle rack on the turret rear. The retrofitting of early M1s with the rack has made telling the difference between them and and IP M1 difficult from certain angles or at long range. (Sewell)

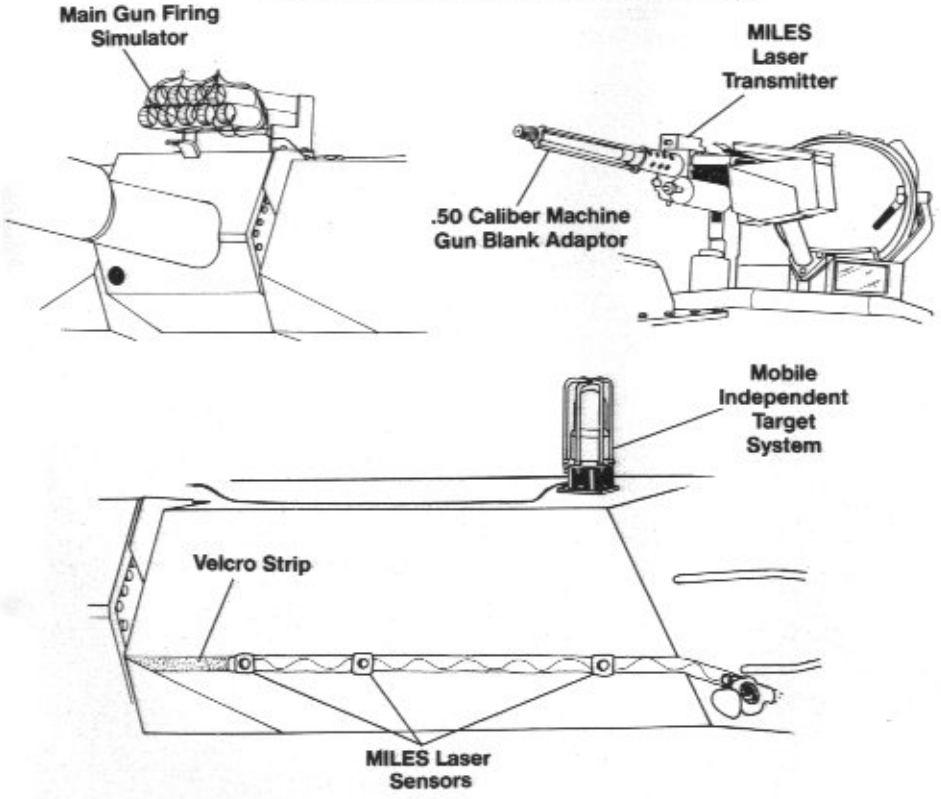
"Bill the Cat" from the Bloom County cartoon strip was carried on the turret faces of all the Abrams assigned to the 1st Platoon, 8th Cavalry for the Canadian Army Trophy competition. Perhaps someday "OPUS" will appear on an M1 like "Bill" and "Garfield." (Sewell)



This Abrams is assigned to H-Troop, 1/12 Cavalry, at Fort Knox and is used to train new armor officers in tank warfare. The author's first sight of a moving Abrams came at six in the morning when its turbine engine woke him up at Fort Knox during the Summer of 1986. (Mesko)

An M1 and M60 parked in the sand at the National Training Center. The M1 is much lower than the earlier M60. Both tanks are covered by dust, which acts as a natural camouflage, helping them blend in with the surrounding terrain. (Stewart)

Specialized Training Equipment



Tanks deployed for training at the NTC are equipped with the MILES laser training equipment. The MILES receiver sensors are attached to the velcro turret strip, a MILES beacon is carried on the turret roof and the commander's .50 caliber machine gun is fitted with a MILES transmitter and an adapter which shreds the wooden portion of the blank so they do not cause injury. (Stewart)

(Above) Eventually a number of M1s were permanently assigned to the NTC for use by units deployed there for training. M1s at the NTC were painted in a desert camouflage scheme and had removable numbers on the armored side skirts made from Green tape. (Green)

(Below) This M1 of the 1st Cavalry is taking part in exercises at the National Training Center (NTC) to test the Abrams under desert warfare conditions. The Abrams carries the insignia of the 1st Cavalry in Black on both sides of the frontal turret armor next to the gun. (Green)

(Below) While the main area of operation for the M1 is still considered to be Europe, the worldwide US commitment means training for operations under different types of terrain. To achieve as much realism as possible, units periodically rotate to the National Training Center for exercises under desert conditions. (Stewart)

Future M1 Variants

As with earlier US tanks, the M1 chassis is being modified to perform a number of roles besides that of main battle tank. Additionally, work is currently underway to fit the Abrams with various devices which will increase its versatility on the battlefield. Because of the relative newness of the vehicle, further developments in the years to come can be anticipated beyond the following modifications.

Tank Test Bed (TTB)

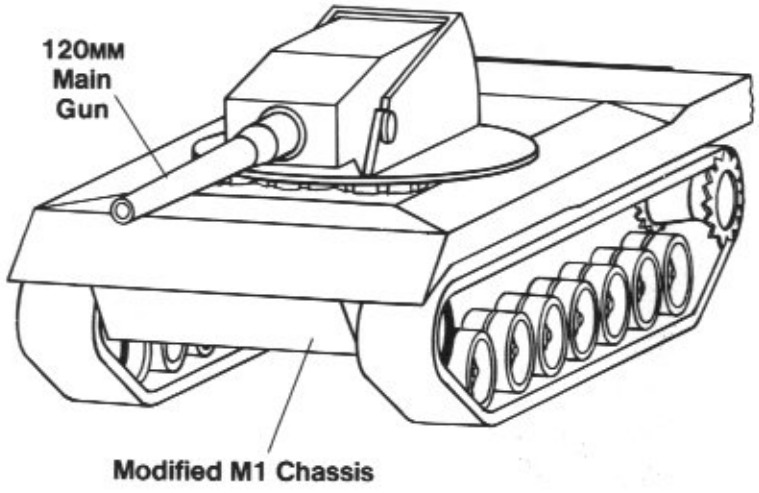
On 22 June 1982 General Dynamics was awarded a 12.9 million dollar contract by the Army Tank Automotive Command (TACOM) to build an experimental Tank Test Bed (TTB) vehicle. This vehicle is intended to explore the possibilities of developing a tank with a low profile unmanned turret armed with one of two different gun systems. Under the terms of the contract the TTB prototype was to be built on a modified M1 chassis. The unmanned turret will be fitted with an automatic loader, new surveillance devices for faster target acquisition, and a remote controlled secondary armament system. Because of the low profile of the unmanned turret, the crew of three will all be seated in the hull where they will have the maximum armor protection. The automatic loader and its ammunition basket will be housed in a separate compartment behind the crew, with the gun externally mounted in a housing above the turret ring. Sighting will be made through the use of electro-optical cameras which will display the targets as TV images for the tank commander and gunner.

Both Rheinmetall of West Germany and Northern Ordnance Division of Ford Motor Corporation were each selected to build separate turret/auto-loader systems for installation on the TTB under close TACOM supervision. After both contractor and Army testing, one of these systems will be selected for full scale engineering development trials.

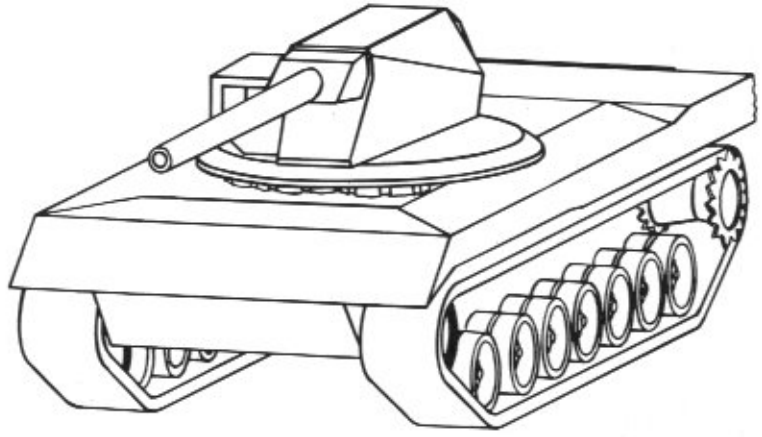
While the project offers great potential in the area of survivability, a number of difficulties must be resolved. The most pressing is the development of a reliable and safe automatic loader. The remote sighting system is still in the developmental stage and it remains to be seen if it will function properly under field conditions. If these problems can be overcome, the TTB vehicle may usher in a new generation of tanks and revolutionize future tank design.

Tank Test Bed Vehicles

Ford Motor Corporation Turret



Rheinmetall Turret



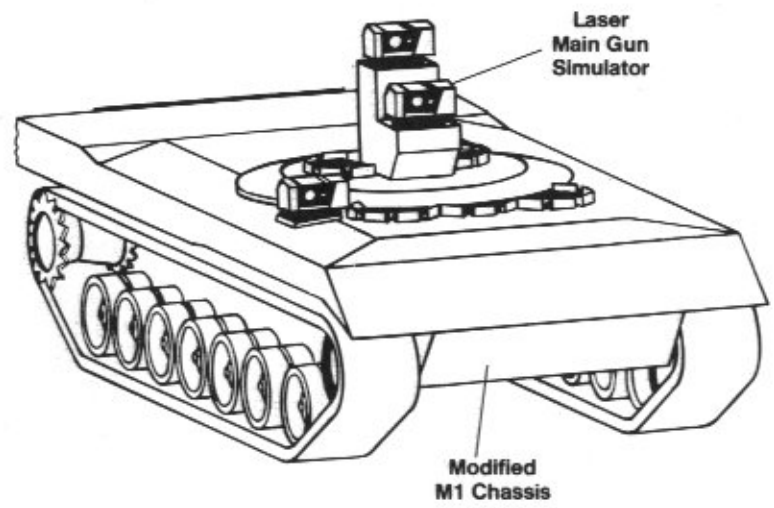
Surrogate Research Vehicle (SRV)

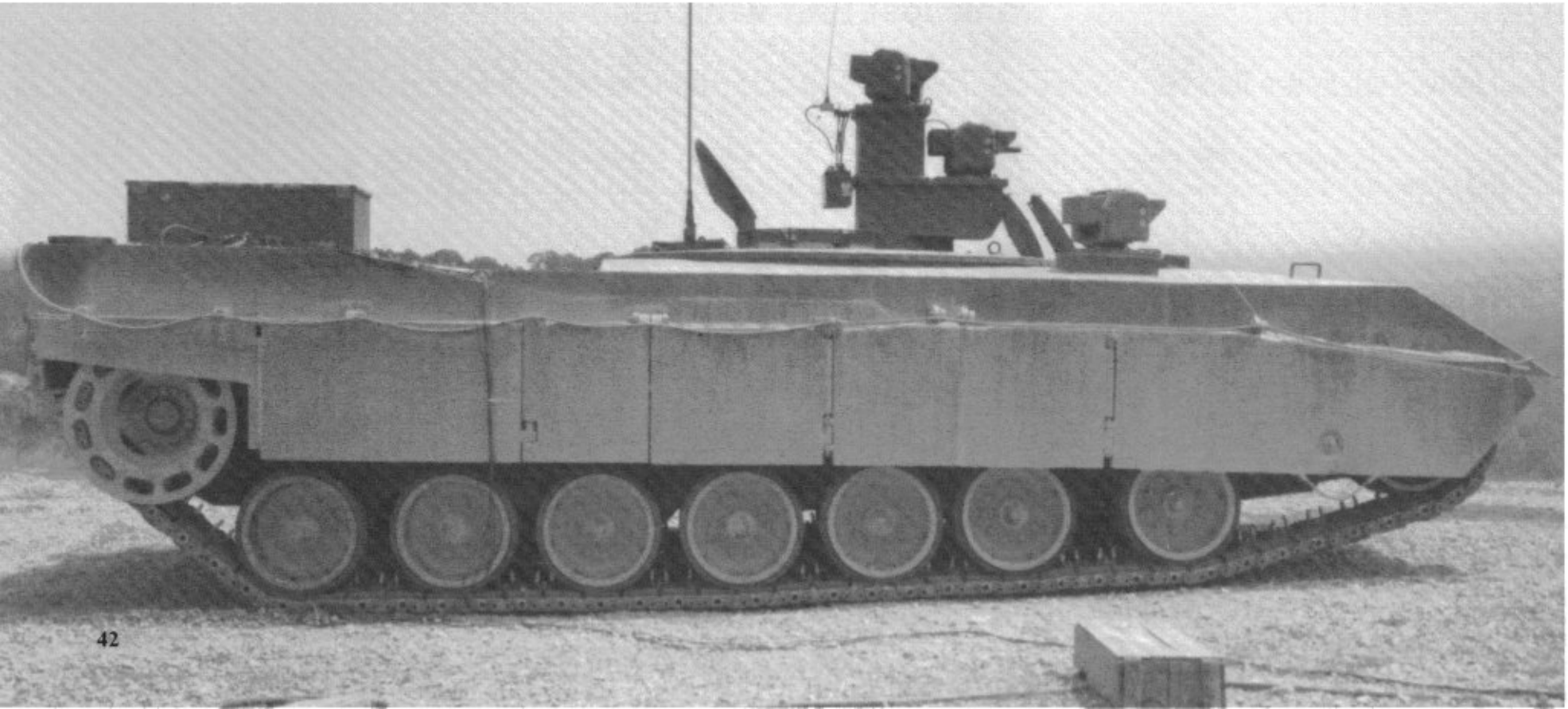
In conjunction with the TTB project, TACOM, working with Litton Systems, Inc. and the Pietzsch Corporation of West Germany, designed and built the Surrogate Research Vehicle (SRV) to explore a number of areas intended for later use in the TTB. Under consideration are crew configuration and size, fire control systems, vision devices, and advanced conceptual concepts. A modified M1 chassis has been fitted with a low simulated turret module, which can be configured with a variety of devices to test different combinations of equipment. The use of modular systems allows changes in the various items of equipment under test to be made easily, until the optimum equipment placement has been found.

The SRV was delivered to the Army during early 1983 configured with a laser main gun simulator in the modular turret housing. Tests with the SRV were begun during June of 1983 and the information gained from this project will be used in the development of the TTB and other projects related to target acquisition, hull/turret components, and command/control devices.

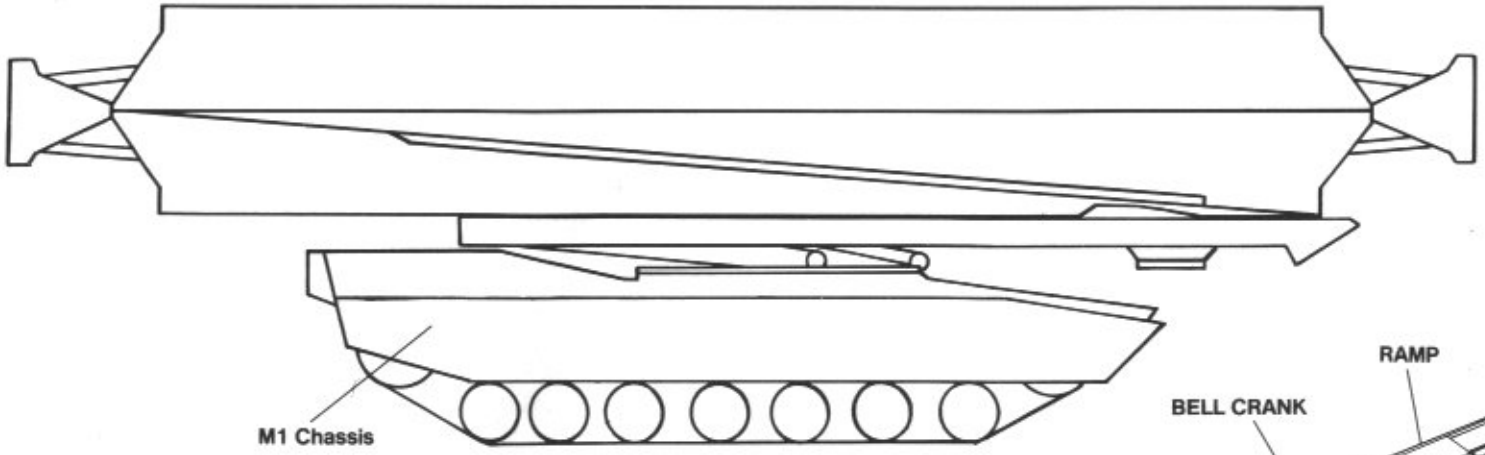
The Surrogate Research Vehicle (SRV) is a modified M1 chassis used to test new equipment and future crew configurations. A special mounting for a laser gun simulator and other sensors, along with their related wiring and transmitters, replaced the standard gun turret. (Green)

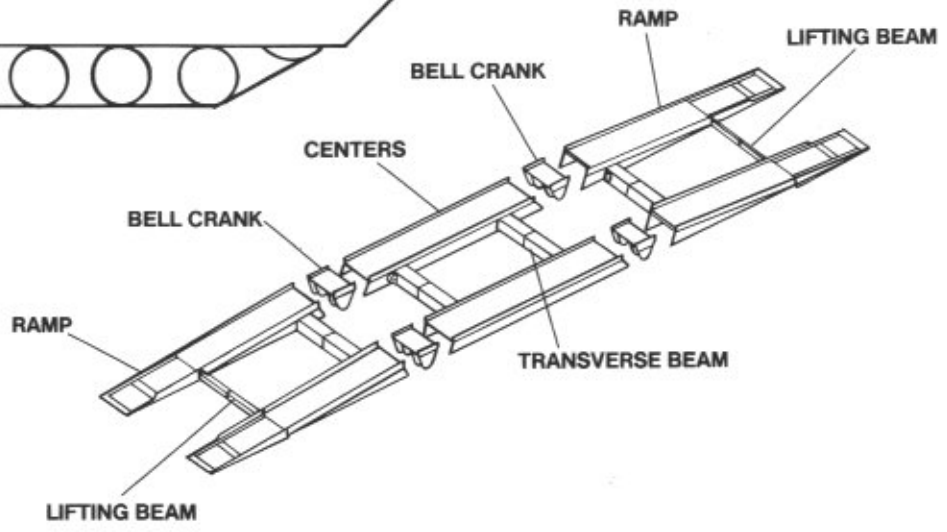
Surrogate Research Vehicle

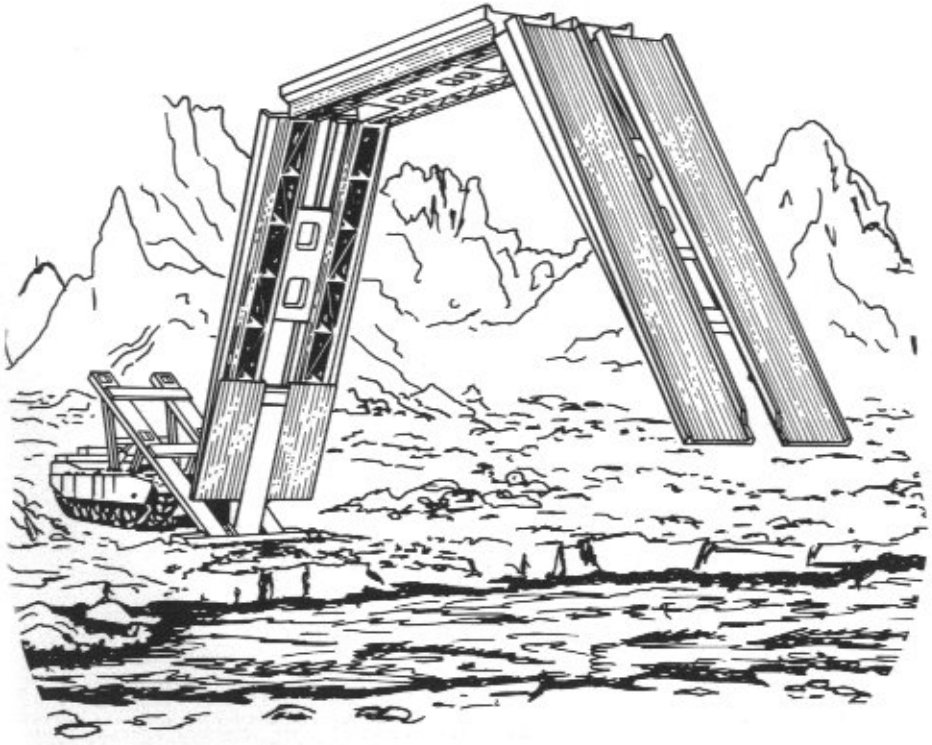




Heavy Assault Bridge System







Heavy Assault Bridge (HAB)

Since the standard M48 and M60 Armored Vehicle Launched Bridge Layers (AVLB) are not capable of keeping up with the M1, the Army has begun development of an M1 Armored Vehicle Launched Bridge to be mounted on the M1 chassis. During 1983 Bowan-McLaughlin-York (BMY) was awarded a development contract to design and build a Heavy Assault Bridge (HAB) for use on the Abrams chassis. Working in cooperation with Israel, a three section bridge was designed for installation on an M1 chassis.

The M1 HAB can span a ninety foot gap, which is a considerable improvement over the sixty foot capability of the older M48 and M60 AVLBs. The M1 HAB unit is 11,000 pounds lighter then the older bridge units because of the extensive use of aluminum and composite materials in its construction. At the current time it is expected that Bowan-McLauglin-York will deliver the prototype for testing in the near future and that the M1 AVLB will enter service with M1 armored units during the early 1990s.

Abrams Recovery Vehicle (ARV)

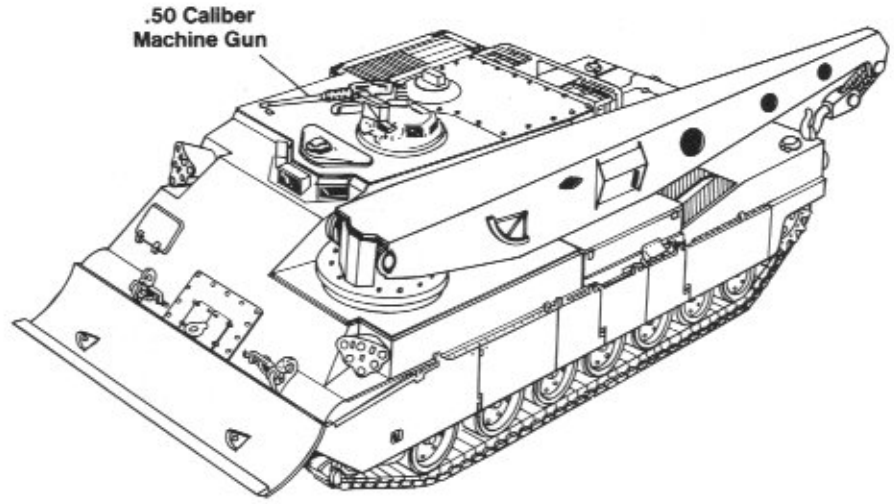
While the M88 Armored Recovery Vehicle (ARV) is expected to meet the Army's needs for the immediate future, preliminary development work is underway on a new recovery vehicle based on the M1 chassis. The Abrams Recovery Vehicle prototype is a sixty-seven ton engineer vehicle which features an armored superstructure that extends from the front glacis plate back to the engine deck with a thirty-five ton crane mounted to the left of the superstructure. The crane can be traversed through 270 degrees and elevated 70 degrees. The superstructure houses the three man crew and has additional seating for the four crewmen from a recovered tank, along with the various items of equipment needed for repair and recovery work.

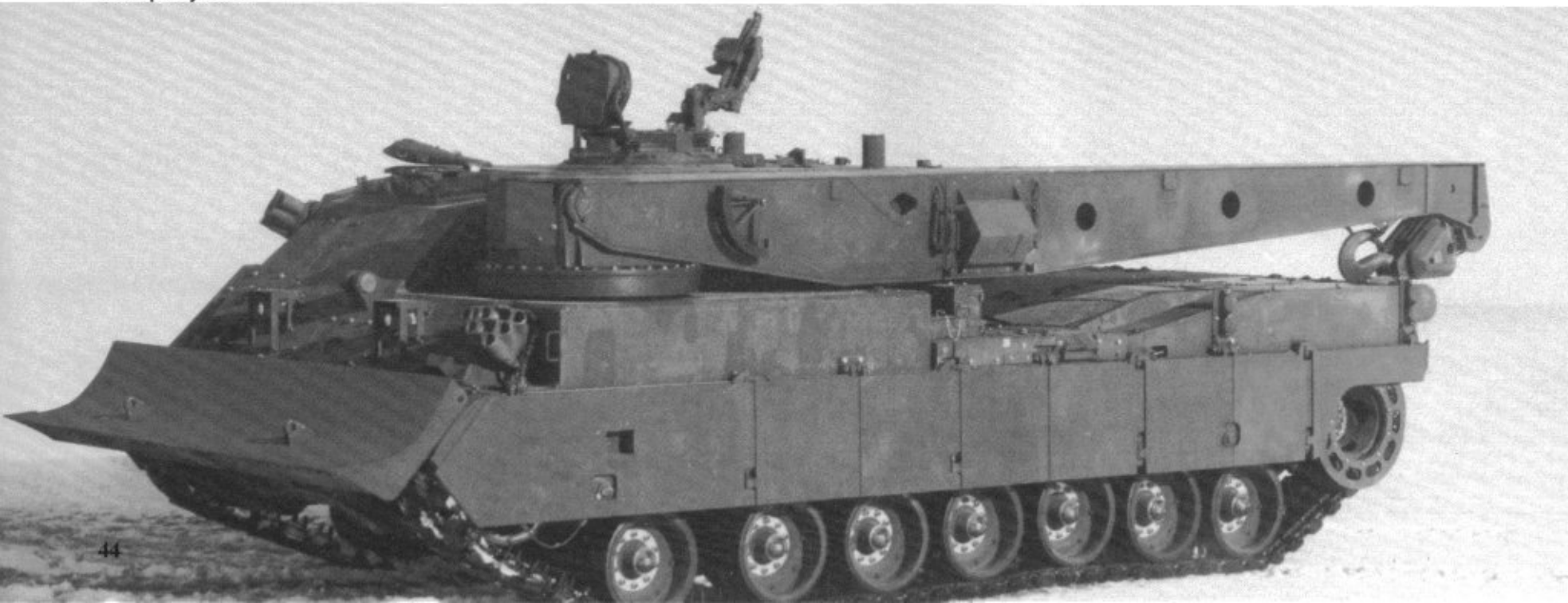
The front of the vehicle mounts a dozer blade for earth moving during recovery operations and the suspension features an independent lockout. Armament consists of a single .50 caliber machine gun with 1,500 rounds of ammunition for close in and anti-aircraft defense, and smoke grenade launchers to provide concealment when engaged in recovery operations. An over-pressure ventilation system is also fitted to provide the crew with protection from the effects of NBC warfare. Based on the M1 chassis, the ARV is 80-90 percent compatible with the M1 in chassis spare parts, cutting down on additional parts needed for the ARV within the Army supply system. Prototype vehicles are currently being tested and developmental work is continuing on the vehicle.

Initial tests revealed that the ARV prototype has a top speed of 40 mph and a range of 310 miles. This performance will allow the ARV to keep up with Abrams units in the field. It is expected that the M1 based ARV will enter series production during the early 1990s.

The Abrams Recovery Vehicle (ARV) is an Armored Recovery Vehicle based on the M1 chassis. The ARV has been developed by General Dynamics to recover damaged M1s from the battlefield. The turret has been replaced by an armored superstructure and a thirty-five ton capacity crane.

Abrams Recovery Vehicle





Fording Equipment

To meet a Marine Corps requirement, work has begun on the development of a water fording kit for the M1A1. The wading kit will consist of an engine exhaust tower mounted on the rear engine deck, two engine air intake towers mounted on the port side of the turret, and a muzzle cap for the main gun. No other special preparations will be necessary to allow the M1A1 to ford depths up to two meters (six and one half feet).

Mine Clearing Vehicle

Anti-tank mines and how to clear them have always presented a major problem for tankers, however, it was not until recent years that the Army made a serious attempt to improve its mine clearing capabilities for tanks. Experience gained in Vietnam, where mines caused the majority of tank losses, coupled with reports and captured Soviet equipment received from Israel, led the Army to develop a mine roller system which is quite similar to one of the Soviet models tested.

Initially it was planned to use this system on the M60, however, with the introduction of the M1 trials were conducted to determine if this unit could be adapted for use on the Abrams. The tests were conducted using a modified M60 mine roller kit which proved that the adaptation was feasible. At the present time the Army is funding production of a modified version of the mine clearance kit for use on the M1 and these should be available to M1 units in the near future.

This M1 was fitted with a version of the mine roller installed on the M60 tank to determine if it could be modified for use on the M1. Aside from minor modifications needed to mount the roller to the M1 chassis, the standard kit worked well and is now being procured for use on the M1. (U.S. Army via Armor Magazine)

Tank Dozer

Tank dozers have been part of the armored inventory since World War II. When the M1 design was laid down, the possibility of fitting the standard M9 bulldozer kit originally designed for use on the M60 was investigated. Tests revealed that while it was feasible to install an M9 dozer on the Abrams, the dozer blade restricted the M1 driver's visibility. Additionally, it was felt that the M9 was not as effective as it could be. As a result the investigating team recommended development of a new, lower profile design which would incorporate improved hydraulics and a rapid coupling/release mechanism.

Work on this new dozer blade was assigned to Research and Development Center at Fort Belvoir, Virginia. After working out plans for the new dozer kit, a contract was given to Barnes and Heineke, Inc. to build a prototype for field testing. The prototype was shipped to Fort Knox during the summer of 1984 for evaluation under field conditions. The unit functioned well and it is currently under consideration for introduction as standard equipment for the M1.

A dozer kit, modified from the M9 bulldozer used on the M60, was installed on the M1 at Fort Belvoir and tested at Fort Knox. Although successful, the tests indicated that a new dozer unit should be designed to take full advantage of the lower silhouette of the M1. (U.S. Army via Armor Magazine)

XK-1/Type 88

During the early and mid-1970s South Korea began a series of arms programs designed to lessen the reliance of the South Korean armed forces on foreign sources of weapons. As part of this program the country started to develop an arms industry capable of refurbishing, manufacturing, and/or assembling (under license) a variety of weapons. Most weapons systems that were selected for production were of American design, such as the Northrup F-5 Tiger II fighter aircraft and Hughes (now McDonnell Douglas) 500 helicopter.

During this same time period the South Korean Army began looking for a replacement for its aging fleet of US supplied M47 and M48 tanks. There was no vehicle on the international market that appealed to the South Koreans, who were faced by a foe armed with some of the latest Soviet armored vehicles. Without a likely candidate for license production, the South Koreans began considering the possibility of designing and manufacturing an indigenous armored vehicle.

This decision led to a series of discussions with the United States government which resulted in an agreement where the U.S. government would fund technical and managerial assistance. Under the terms of the agreement, private American companies would assist with the design of a modern battle tank to be built in South Korea. The South Korean Army formulated a specific design requirement which was circulated by the Hyundai Rolling Stock Company of South Korea to various American manufacturers who were invited to submit proposals. After due consideration South Korea selected the proposal submitted by the Chrysler Corporation and a contract was awarded for two prototypes under the designation XK-1 ROKIT (Republic of Korea Indigenous Tank).

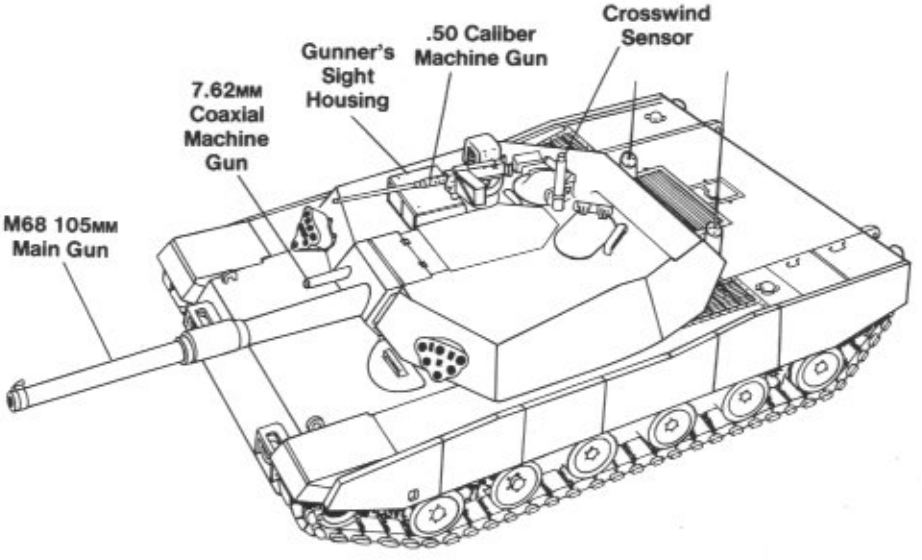
The first prototype, an Automotive Test Rig (ATR), was completed in mid-1983, arriving at the Aberdeen Proving Grounds during November. The ATR was fitted with a non-operational turret and was used to test the vehicle's endurance and reliability under fully loaded conditions. The prototype showed a great deal of influence from the XM1 and is quite similar in external appearance. This was to be expected because Chrysler had used the XM1 as a general pattern vehicle when designing the original proposal for the XK-1.

When General Dynamics purchased the tank division of Chrysler in March of 1982, they also purchased the rights to the XK-1 and continued its development. Despite the outward similarity to the XM1, internally the two tanks were totally different. The XK-1 had a lower profile and was approximately eight tons lighter (53 tons). Instead of the turbine engine, it was powered by a Teledyne Continental 1,200 hp AVCT-1790 diesel engine. This engine was chosen because it had already been proven in the General Dynamics High Performance M60 MBT project. This engine gave the XK-1 a much better power to weight ratio then earlier 900 hp AVCT-1790 series engines, which were used in the M60A3. This increase in power is a distinct advantage in the hilly South Korean countryside.

The specification called for the main armament of the XK-1 to be the M68E1 105MM rifled cannon, the same weapon used on the XM1. Secondary armament consisted of a .50 caliber machine gun mounted on the starboard side of the turret roof for the tank commander and two 7.62 MM M60 machine guns, one mounted coaxially with the main gun and the other on the port side of the turret roof for the loader (optional) . Internal ammunition storage capacity is forty-six rounds of 105MM ammunition, 8,600 rounds of 7.62MM ammunition and 2,000 round of .50 caliber ammunition. The fire control system is similar to that used in the XM1, although the gunner has a binocular eyepiece replacing the monocular optics of the XM1. Additionally the XK-1 is equipped with stabilized optics and a vertical sensor.

The similarity between the M1 and the South Korean XK-1 is not accidental because the contractor, Chrysler/General Dynamics used much of the experience gained with the M1 project in its design. The XK-1, however, has a lower profile and is some eight tons lighter than the M1. (Green)

XK-1 Rokit (Republic of Korea Indigenous Tank)



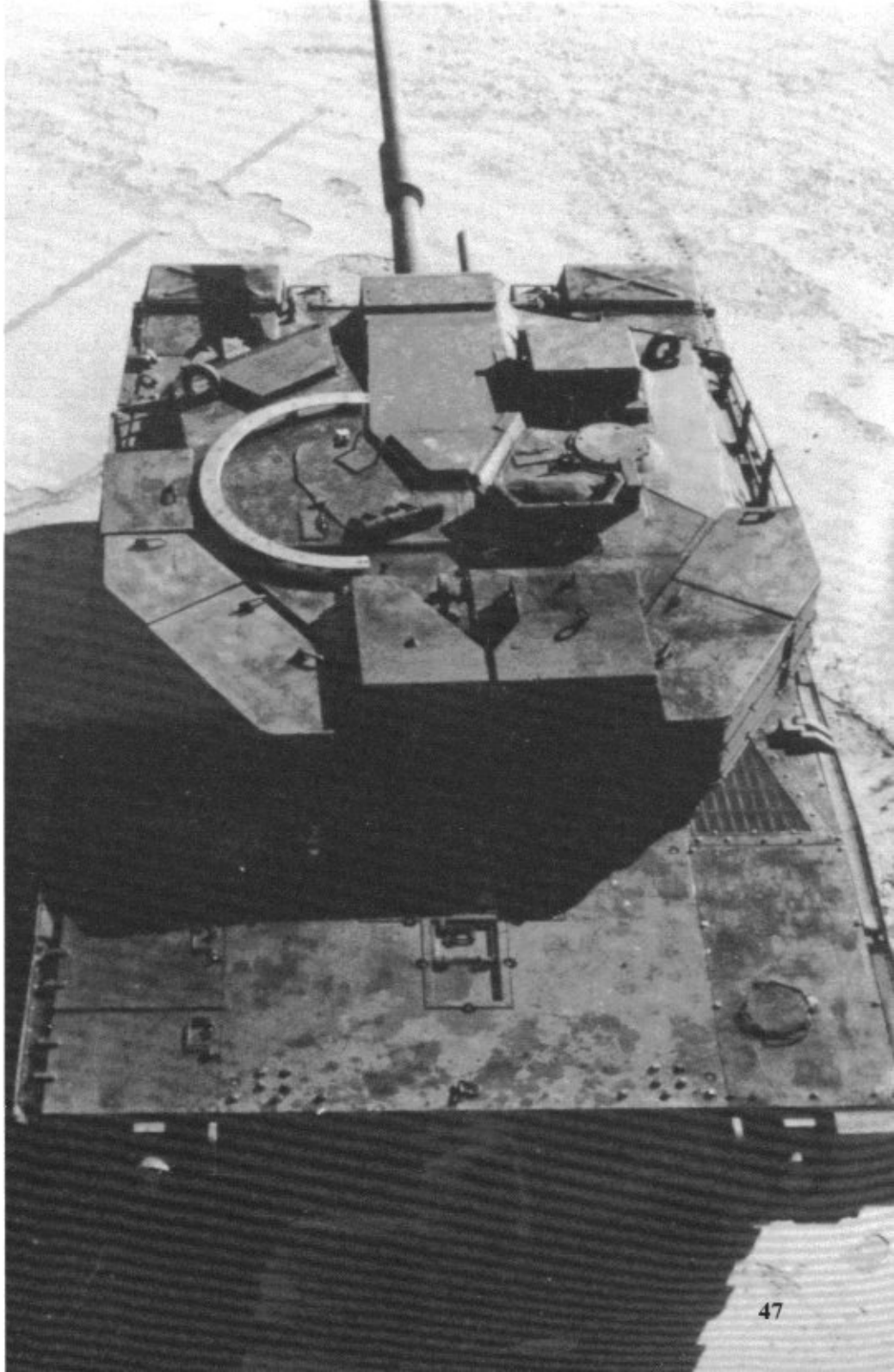
The suspension of the XK-1 is a unique combination of torsion bars and hydro-pneumatic units. The front two and last road wheels are hydro-pneumatic while the center three road wheels are carried on torsion bars. This allows the crew to pivot the tank longitudinally on the center wheels by raising and lowering the front and rear bogies. This gives the crew additional gun laying capabilities. The driver can also increase or decrease track tension from inside the vehicle which allows him to compensate for differences in terrain. During cross country travel, he can tighten the track giving the tank a smoother ride. On smooth roads, he can lessening the tension giving the tank a higher speed. The unusually large road wheel travel also allows the tank to cross rough terrain at a relatively high rate of speed while maintaining a relatively smooth gun platform and causing a minimum of crew discomfort.

With the exception of the driver, who is seated in the hull, the crew of the XK-1 are housed in the turret. The driver's position is on the port side of the hull with ammunition storage bins for the main gun located to his right. The Tank Commander and gunner are seated on the starboard side of the turret, with the loader's position on the port side. Stowage boxes arranged alongside and to the rear of the turret give additional protection for the crew by providing a dead space in which shaped charge anti-tank warheads can disperse some of their energy before reaching the main armor.

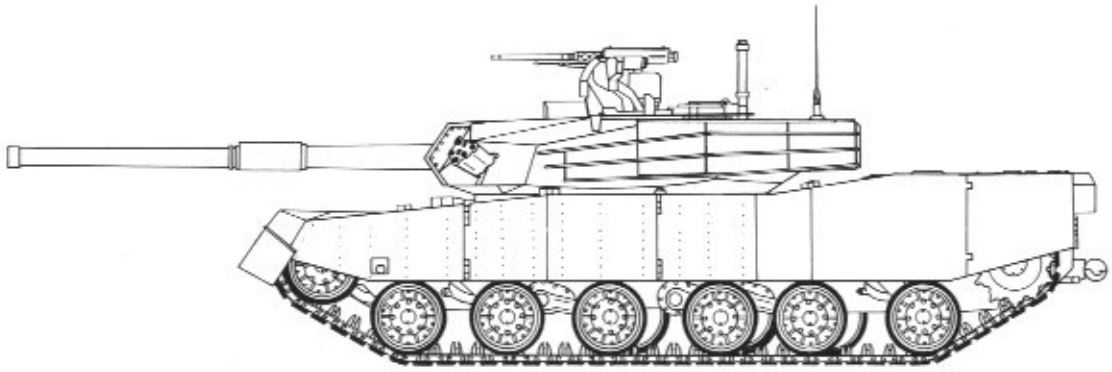
A second prototype, a Fire Control Test Rig (FCTR), was completed in December of 1983 and sent to Aberdeen two months later. This prototype was fitted with a fully operational turret and upon arrival at Aberdeen began a series of fire control tests. Throughout their testing programs both vehicles performed up to expectations with very few problems, none of which were major. The field tests revealed that the XK-1 had a top speed of 37 mph and a range of 310 miles (at 23 mph).

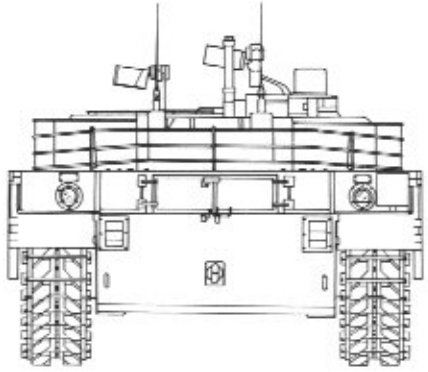
As a result of the successful test program, a production contract was awarded to Hyundai for an unspecified number of tanks under the designation Type 88. The production Type 88 differed from the prototype XK-1 in having a German 1,500 hp MTU MB871 KA V-8 diesel engine in place of the 1,200 hp AVCR-1790. Production began during 1985 and the first Type 88 tanks began rolling off the assembly line during the Fall of 1987. The Type 88 made its first public appearance in October of 1987 during the annual South Korean Armed Forces Day parade in Seoul.

Although no production figures have been released, sufficient facilities exist for production of approximately a thousand vehicles. It is expected that the Type 88 will replace the M47s (300-400) and M48s (200-300) in service with the South Korean Army. Additionally it is anticipated that a further 600 may be produced to replace the modernized M48s in South Korean Army units as they reach the end of their useful service lives during the 1990s. The Type 88 should provide South Korea with a viable weapons system well into the 21st century, much like its bigger brother the M1 Abrams.



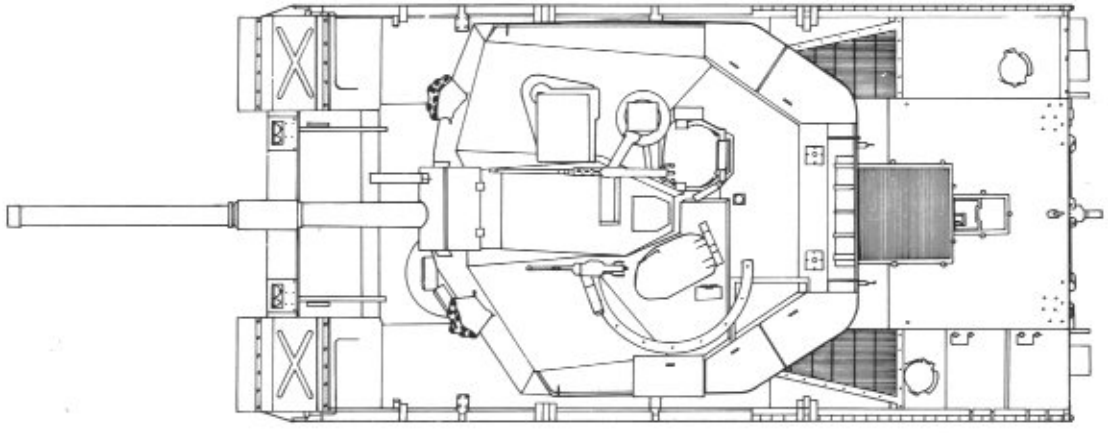
The stowage boxes surrounding the XK-1s turret help enhance the vehicle's protection against shaped charge warheads by providing additional dead space out from the turret armor. (Green)





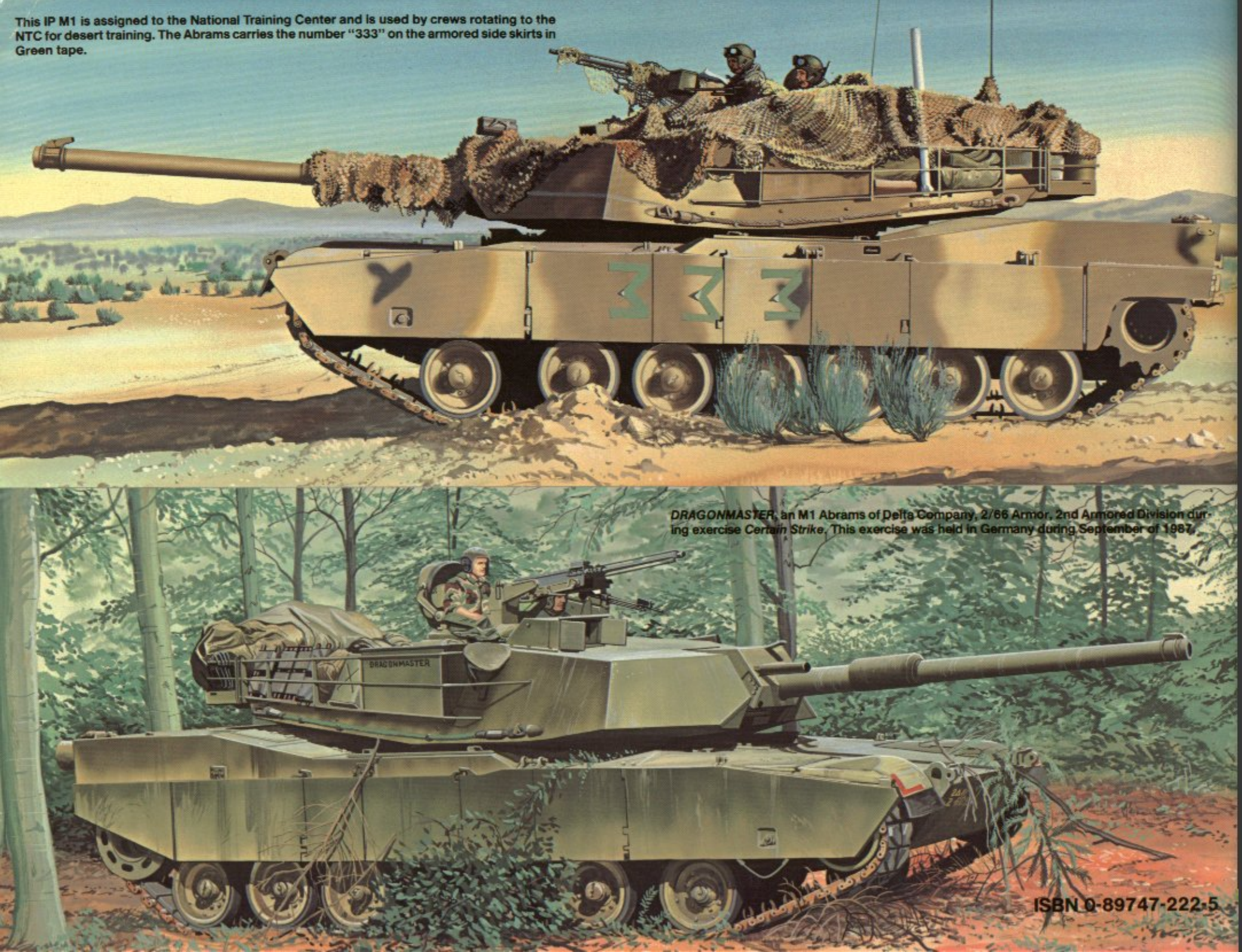
Specifications
Type 88

Length	31 feet 6 inches
Height	7 feet
Width	12 feet
Maximum Weight	53 tons
Powerplant	One 1,200 hp diesel engine
Armament	
Main:	M68E1 105MM rifled cannon
Secondary:	One .50 caliber machine gun
	Two 7.62MM machine guns
Performance	
Maximum Speed	37 mph
Range	310 miles
Crew	Four



(Above) The XK-1 features a combined torsion bar/hydro-pneumatic suspension which allows the tank to "kneel" for additional depression of the main gun. The system also gives the vehicle a smoother ride over rough terrain. The first two and last bogie wheels are pneumatic while the middle wheels are attached to a torsion bar. (Green)

(Below) The XK-1 is armed with the M68 105MM rifled cannon, the same weapon used on the XM1/M1 and a coaxial 7.62MM machine gun with a barrel extension tube which is identical to the mounting on the M1. (Green)



This IP M1 is assigned to the National Training Center and is used by crews rotating to the NTC for desert training. The Abrams carries the number "333" on the armored side skirts in Green tape.

DRAGONMASTER, an M1 Abrams of Delta Company, 2/66 Armor, 2nd Armored Division during exercise *Certain Strike*. This exercise was held in Germany during September of 1987.

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